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PCN APPENDIX E3.1 ISSUE 10 DATED 18th JUNE 2021

IMPLEMENTATION DATE: 1st AUGUST 2021

PCN CERTIFICATION OF PERSONNEL FOR:

- **BASIC RADIATION SAFETY CERTIFICATION (BRS)**

AND / OR WHERE REQUIRED FOR:

- **ADVANCED RADIATION SAFETY (ARS) CERTIFICATION FOR CONSIDERATION BY THE EMPLOYER WHEN APPOINTING PERSONS AS RADIATION PROTECTION SUPERVISORS (RPS)**

1. SCOPE:

- 1.1 This document contains procedures by which personnel may be examined against and where successful within the PCN examination issued certification for Basic Radiation Safety and/or where required, Advanced Radiation Safety (ARS) certification for consideration by the employer when appointing Radiation Protection Supervisors (RPS). Requirements contained herein are supplementary to those contained within PCN General Requirements documents for PCN Certification of NDT Personnel.
- 1.2 This document details the specific PCN training and experience requirements to demonstrate eligibility when attempting PCN Radiation Safety certification examinations.
- 1.3 The document provides the candidate with details of the critical knowledge required for radiation safety in preparation for the operations they may perform within their employer appointed roles.
- 1.4 Candidates for PCN Industrial Radiography certification who hold existing valid PCN certification for Basic Radiation Safety and/or Advanced Radiation Safety certification required for RPS roles will be exempt any further safety examinations when seeking PCN certification for Industrial Radiography.

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2. INTRODUCTION:

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

2.1 Basic Radiation Safety (BRS): BRS certification should be held by all persons practicing industrial radiography demonstrating that they have been adequately trained in the hazards associated with ionising radiations, the precautions to be taken when employing ionising radiation, and the methods of protection used. He or she will be aware of the content and importance of complying with any special requirements for permanent facility or site operations, as well as possible accident or emergency situations which can arise, and the actions to be taken in the event of such occurrences. In this instance both the employer and candidate shall pay particular attention to Regulation 15 of the UK Ionising Radiations Regulations 2017 which states:

2.1.1 IRR 2017 - 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 IRR 2017 approved code of practice)

2.2 Advanced Radiation Safety certification (ARS) – Certification to Radiation Protection Supervisor level (RPS): This is an optional and advanced level of certification for holders of Radiographic Testing certification in industrial radiography who wish to be considered as suitable for appointment as a Radiation Protection Supervisor (RPS) by their employer.

By achieving success in a PCN ARS examination candidates have demonstrated that they possess the knowledge, skills, and characteristics for appointment as an RPS under Regulation 18 of the Ionising Radiations Regulations 2017 approved code of practice guidance document for work with ionising radiation.

A candidate for PCN ARS certification will have been adequately trained in the requirements for appointment to the post of Radiation Protection Supervisor by the employer and in addition, will have been assessed for knowledge and understanding of the requirements to assess dose, carry out hazard assessments, implement contingency plans and emergency procedures, arrange for the provision of dosimeters and the keeping of dose records etc.

In part regulation 18 confirms that:

2.2.1 (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.

2.2.2 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.

(e) know what to do in an emergency.

2.2.3 *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 Advisor (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 IRR 2017 approved code of practice).

3. ELIGIBILITY FOR PCN RADIATION SAFETY CERTIFICATION:

All candidates must have successfully completed a PCN approved course of training for BRS or ARS certification as required and have accumulated the required amount of industrial experience as defined below:

3.1 **Basic Radiation Safety certification (BRS):** Candidates shall have successfully completed a PCN approved course of theoretical training at a BINDT Approved Training Organisation (ATO) comprising of 16 hours formal training to the appropriate part of the syllabus detailed PCN Appendix E3.2:

3.1.1 PCN APPENDIX E3.2. EXAMINATION SYLLABUS FOR THE CERTIFICATION OF PERSONNEL IN RADIATION SAFETY AND PROTECTION.

3.2 **Advanced Radiation Safety certification (ARS) to (Radiation Protection Supervisor Level (RPS)):**

All candidates shall:

3.2.1 Hold a current PCN BRS certificate, or other alternate radiation safety certification acceptable to BINDT.

3.2.2 Have successfully completed a PCN approved course of training at an ATO comprising an additional 24 hour's formal training to ARS level.

3.2.3 Provide verifiable evidence of nine months relevant industrial experience as a holder of a PCN Basic Radiation Safety certification, or other alternative radiation safety certification recognised by BINDT.

3.2.4 Evidence of relevant BRS experience required at (3.2.3) for BRS may be gained post BRS examination.

3.2.5 Where this is the case at (3.2.4) PSL57C shall be completed by the candidate and submitted to PCN confirming the required amount of industrial experience has been successfully achieved prior to the issue of ARS certification to the candidate by PCN.

- 3.3 **NOTE:** *As per the requirements of IRR 2017, 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 Due to variations in the industrial application of radiography, it is impossible to differentiate between the requirements of a site radiographer and an operator concerned with only one specific task in an exposure bay equipped with mechanical/electronic safety controls. Therefore, radiation safety aspects must apply equally to all personnel in that both basic and advanced radiation safety certification assessments shall include competence assessment for laboratory, site, and workshop conditions.

4.2 BASIC RADIATION SAFETY EXAMINATION:

- 4.3 BRS Applications for certification examinations shall be submitted to a PCN Authorised Qualifying Body (AQB) directly using PCN form PSL/57.

4.4 BRS written examination format for (X-Ray) or (X and Gamma Ray):

- 4.4.1 A written examination consisting of 30 multi-choice theory questions set at the knowledge level for BRS. All multi-choice questions having a choice of 4 possible answers, 1 of which shall be correct, the remaining other possible answers being wrong or incomplete.
- 4.4.2 As a minimum 1 of the 30 multi-choice questions will include a calculation at a level appropriate for BRS certification.
- 4.4.3 Time allowed per question 2 minutes.
- 4.4.4 Total examination time 60 minutes.
- 4.4.5 Grade required to pass 70%.

4.5 ADVANCED RADIATION SAFETY EXAMINATION. CERTIFICATION TO RADIATION PROTECTION SUPERVISOR LEVEL:

- 4.6 ARS applications for certification examinations shall be submitted to a PCN AQB directly using PCN form PSL/57.

4.7 ARS written examination format for (X-Ray) or (X and Gamma Ray):

- 4.7.1 A written examination consisting of 30 multi-choice theory questions set at the knowledge level for ARS. All multi-choice questions having a choice of 4 possible answers, 1 of which shall be correct, the remaining other possible answers being wrong or incomplete.
- 4.7.2 As a minimum, 2 from 30 multi-choice questions will include calculations at a level appropriate for ARS certification.
- 4.7.3 Time allowed per question 3 minutes, 90 minutes total examination time.
- 4.7.4 Grade required to pass 70%

5. CERTIFICATION AVAILABLE:

5.1 Basic Radiation Safety (BRS) Level 1

5.1.1 For X-ray only

5.1.2 For both X and Gamma ray

5.2 Advanced Radiation Safety (ARS) (Certification to Radiation Protection Supervisor level (RPS) Level 2

5.2.1 For X-ray only

5.2.2 For both X and Gamma ray

5.3 NOTE: PCN radiography certificates are valid only so long as the certificate holder holds valid PCN radiation safety certification, or other valid radiation safety certification recognised by the British Institute of NDT.

6. PROCEDURE FOR RECERTIFICATION:

6.1 There is no recertification for PCN (BRS) or (ARS) certification without a further full assessment examination.

6.2 Personnel whose PCN (BRS) or (ARS) certification expires at the end of the maximum five-year period of validity shall attempt the initial examination process comprised of:

6.3 Basic Radiation Safety:

6.3.1 A written theory examination as per the requirements contained at 4.2 herein.

6.4 Advanced Radiation Safety certification to (RPS)level:

6.4.1 A written theory examination as per the requirements contained at 4.5 herein.

6.5 Where there has been any change in radiation safety regulations or legislation since issue of the expiring PCN certificate, candidates will be required to demonstrate that they have undertaken additional and relevant refresher training at an ATO covering the new legislation or regulations prior to attempting the recertification examination at an AQB.

7. COMPLAINTS AN APPEALS:

7.1 **Complaints:** An aggrieved party in a dispute which considers itself to have reasonable grounds for questioning the competency of a PCN certificated individual may petition for withdrawal or cancellation of certification, any such petition must be accompanied by all relevant facts. Where it is established that an adequate case has been presented, a full investigation of the circumstances under dispute will be initiated.

7.2 In the first instance details of the complaint should be supplied in writing using PCN document CP21.

7.2.1 <https://www.bindt.org/admin/Downloads/CP21.pdf>

7.2.2 Each complaint or appeal will be acknowledged, investigated, and resolved. Verbal complaints will not be accepted.

7.3 If the petition is substantiated to the satisfaction of the BINDT Certification Management Committee (or a committee to which the CMC has assigned responsibility for such matters), the certification may be withdrawn for a period of time as defined by the investigating committee. To regain certification at the end of the period for which certification was withdrawn the candidate will be required to be successful in a further initial PCN examination.

7.4 **Appeals:** Appeals against certificate cancellation, failure to certify or recertify may also be made in accordance with the guidance contained within document CP21 by the candidate or certificate holder by application in writing to the PCN Scheme Manager.

7.5 The CMC may delegate the process of dealing with complaints and appeals to a properly constituted sub-committee.

8. REFERENCE LITERATURE:

Textual references are considered essential reading.

Recommended reading references given below but not mentioned in the syllabus are considered recommended reading.

8.1 Essential Reading:

8.1.1 The Ionising Radiation Regulations, 2017 Statutory Instrument No. 1075:

<https://www.legislation.gov.uk/uksi/2017/1075/contents/made>

8.1.2 Working with ionising radiation. Ionising Radiations Regulations 2017. Approved Code of Practice and guidance: <https://www.hse.gov.uk/pubns/books/l121.htm>

8.1.3 HSE information sheet Industrial radiography - managing radiation risks Ionising Radiation Protection: <https://www.hse.gov.uk/pubns/irp1.pdf>

8.1.4 Managing industrial site radiography work:

<http://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 Regulation 2002:

<https://www.hse.gov.uk/pubns/books/l132.htm>

8.2 Recommended Reading:

8.2.1 Relevant British, European or international standards

8.2.2 IRID: Information on the Ionising radiation incident database:

https://www.hse.gov.uk/foi/internalops/ocs/500-599/oc560_35.htm#:~:text=4%20IRID%20stores%20radiological%20data,radioactive%20materials%20to%20the%20environment.

8.2.3 Public Health England Website:

<https://www.gov.uk/government/organisations/public-health-england>

9. SUMMARY OF CHANGES:

Issue Number	Issue Date	Summary of document changes
9	1 st July 2019	Process for post experience included
10	18 th June 2021	Document re-write to meet revised training document requirements. Full review.

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PCN APPENDIX E3.2 ISSUE 10 DATED 18th JUNE 2021

IMPLEMENTATION DATE: 1st AUGUST 2021

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

ASSOCIATED DOCUMENTS:

PCN APPENDIX E3.1 ISSUE 10 - April 2021

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

APPENDIX E3.3 to PCN/GEN - April 2021

Specimen examination questions for the certification of personnel in (Basic Radiation Safety (BRS)) and (Advanced Radiation Protection to supervisor level (RPS)).

1 INTRODUCTION:

Unless otherwise stated all examinations are 'closed book' and although the general syllabus for both levels of certification remains the same, the degree of difficulty and therefore depth of knowledge required shall increase commensurately from Basic Radiation Safety to Radiation Protection Safety at Supervisor level.

Candidates for BRS examination should possess a general knowledge of the syllabus subjects listed and, an awareness of the contents of the documents indicated.

Candidates for RPS examination would be expected to have an in-depth knowledge for all aspects of the syllabus subjects herein, and of the contents of documents listed.

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2 BASIC RADIATION SAFETY (BRS):

Candidates will have attended a structured course of classroom training at a BINDT Approved Training Organisation (ATO). At the end of the course candidates should:

- 2.1 Have an understanding of the basic concepts of ionising radiations.
- 2.2 Be familiar with the terminology used in radiation protection.
- 2.3 Be familiar with the main requirements of the following:
 - 2.3.1 The Ionising Radiations Regulations 2017: <https://www.legislation.gov.uk/ukxi/2017/1075/contents/made>
 - 2.3.2 The Approved Code of Practice: <https://www.hse.gov.uk/pubns/books/l121.htm>
 - 2.3.3 Associated Guidance / approved training notes
- 2.4 Have an understanding of the potential hazards (health effects) associated with use of ionising radiation.
- 2.5 Have an understanding and be able to apply the principles of practical radiation protection to minimise exposure to ionising radiation.
- 2.6 Have an understanding of good working practices required to keep radiation doses As Low As Reasonably Practicable (ALARP), for both site and compound radiography.
- 2.7 Be able to calculate source intensity and dose rates, understand and apply the inverse square law.
- 2.8 Be aware of the appropriate action to take in emergency situations.

NOTE:

The minimum total recommended lecture time required to cover the syllabus requirements for BRS is 16 hours.

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

The minimum approved training hours are included only for guidance purposes and are not intended to prevent the approved training organisation adopting additional alternative training hours where it is deemed by the ATO that additional training time would be required to ensure candidates are fully prepared for the certification examination, and the subsequent BRS roles and responsibilities.

3 ADVANCED RADIATION SAFETY CERTIFICATION (ARS) - Radiation safety certification to Radiation Protection Supervisor level (RPS):

Potential candidates for ARS training and examination will have, previously completed an approved training course and been successful in a subsequent PCN examination for Basic Radiation Safety and have accrued a minimum of 9 months industrial experience deploying Basic Radiation Safety certification within the industrial environment.

Radiation Protection certification to Supervisor level is intended for personnel who are to be appointed as Radiation Protection Supervisors (RPS) by the employer for site and/or compound radiography at the employers, or employers' customers facilities.

The regulations require that the RPS knows and understands the requirements of the latest edition of the (IRR) Regulations, and of local rules as they effect the work he or she supervises. They shall understand the necessary precautions to be taken for the work being carried out, and the extent to which these precautions will restrict exposures.

At the end of the course, candidates should in addition to the requirements for BRS:

- 3.1 Have a detailed understanding of the basic concepts of ionising radiations.
- 3.2 Understand thoroughly all the terminology used in radiation protection.
- 3.3 Have a detailed understanding of the main requirements of the following:
 - 3.3.1.1 The Radioactive Substances Act 1993: <https://www.legislation.gov.uk/ukpga/1993/12/contents>
 - 3.3.1.2 The Ionising Radiations Regulations 2017: <https://www.legislation.gov.uk/uksi/2017/1075/contents/made>
 - 3.3.1.3 The Approved Code of Practice: <https://www.hse.gov.uk/pubns/books/l121.htm>
 - 3.3.1.4 Associated Guidance / approved training notes.
 - 3.3.1.5 The Transport Regulations: <https://www.legislation.gov.uk/uksi/2002/1093/contents>
 - 3.3.1.6 Have a thorough understanding of the potential hazards (health effects) associated with the use of ionising radiation.
 - 3.3.1.7 Have a thorough understanding of the principles of practical protection to minimise exposure to ionising radiation.
 - 3.3.1.8 Understand good working practices required to keep radiation doses As Low as Reasonably Practicable (ALARP), for both site and compound radiography.
 - 3.3.1.9 Understand fully, the role and duties of the RPS and be fully aware of the various records that need to be maintained.
 - 3.3.1.10 Be able to calculate source intensity and dose rates and carry out inverse square law and shielding calculations required to keep radiations doses ALARP.
 - 3.3.1.11 Have a detailed understanding and be able to take control of emergency situations through use of agreed and authorised procedures.

NOTE:

The total recommended lecture time required to cover the syllabus at a level suitable for RPS appointment by the employer is: 24 hours of structured training.

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

Minimum approved training hours are included only for guidance purposes ONLY and are not intended to prevent the ATO adopting additional alternative training hours where it is deemed NECESSARY by the ATO that additional training time is required to ensure that candidates are prepared for future appointment to the role of RPS by the employer, in full.

4 SYLLABUS CONTENT:

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EXAMINATION SYLLABUS FOR THE CERTIFICATION OF PERSONNEL IN RADIATION SAFETY AND PROTECTION (BRS) AND (RPS)	
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1.11	ARTIFICIAL RADIONUCLIDES
1.12	DECAY

	1.13	CORPUSCULAR (PARTICULATE) RADIATION: Alpha Radiation / Beta Radiation / Neutron Radiation.
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2	EQUIPMENT USED FOR INDUSTRIAL RADIOGRAPHY:	
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	2.2	X-RAY SOURCES: Generation of X-rays / The X-ray Equipment Control Panel / Timer / Milliamps (mA) Control / Kilovoltage (kV) Control.
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3	QUANTITIES AND UNITS:	
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	5.3	MAKING MEASUREMENTS.
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	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 / Thermo-luminescent dosimeters (TLD) / Personal Alarm Monitors or Personal Electronic Dosimeters (PED) / Care of passive dosimeters / Lost dosimeters / Exposed or defective dosimeters.
	5.7	DOSE INVESTIGATIONS: Unusual exposure / ALARP Investigation / Over-exposure investigation.
6		LEGAL REQUIREMENTS:
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	6.2	IONISING RADIATIONS REGULATIONS 2017: Approved Code of Practice (ACOP) / Guidance Notes.
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		AUTHORISATION: (Regulations 5, 6 & 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 ADVISOR: (Regulation 14)
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		Time:
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	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
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	7.3	SOURCE STORAGE FOR GAMMA RADIOGRAPHY.
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		Summary of requirements and procedures: Risk assessment / Local Rules / Dosimetry / Sources and containers / Routine conditions of transport / Foreseeable incidents / Security
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PCN/GEN APPENDIX E3.3 ISSUE 10 DATED 18th JUNE 2021

IMPLEMENTATION DATE: 1st AUGUST 2021

SPECIMEN EXAMINATION QUESTIONS FOR THE CERTIFICATION OF PERSONNEL IN RADIATION SAFETY AND PROTECTION.

ASSOCIATED DOCUMENTS:

APPENDIX E3.1 to PCN/GEN:

Specific Requirements for the Certification of Personnel in Radiation Safety and Protection.

APPENDIX E3.2 to PCN/GEN:

Examination Syllabus for the Certification of Personnel in Radiation Safety and Protection.

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1 GENERAL INFORMATION:

Source activities or dose rates to be used within the example questions are given in dual units on the paper. e.g.

- 740 GBq ⁶⁰Co (20 Ci ⁶⁰Co)
- 185 GBq ¹⁹²Ir (5 Ci ¹⁹²Ir)

1.1 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:

- 1.1.1 Concrete
- 1.1.2 Steel
- 1.1.3 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, 2 minutes per question.

The following example questions are indicative of the type and complexity of question which 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 metre from a source is 10 $\mu\text{Sv}/\text{hour}$. The distance required to reduce this to 2.5 $\mu\text{Sv}/\text{hr}$ is:

- a) 2 metres
 - b) 5 metres
 - c) 10 metres
 - d) 20 metres
-

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) greater than 150 mSv/yr for the skin
- b) an equivalent dose greater than 15 mSv/yr for the lens of the eye
- c) an effective dose greater than 6 mSv/yr
- d) all answers are correct

3 RADIATION PROTECTION (to Supervisor level) AND EXAMPLE QUESTIONS:

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

The examination will also include calculations

The examination will also multi-choice questions which will require the candidate to select the correct answers provided to them from within paragraphs of narrative text. This will require an 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 which the candidate may be expected to answer in a PCN ARS examination to supervisor level.

1. Every employer shall designate as a controlled area, any area under his control which 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 his employees for the first time in any calendar year exceeds:
- a) 1 mSv/yr
 - b) 2 mSv/yr
 - c) an effective dose greater than 6 mSv/yr
 - d) 10 mSv/yr
-

4. You are required to carry out on-site radiography from the centre of a 20 metre long x 4 metre diameter 45 mm WT steel pipe using a panoramic technique with an Iridium 192 isotope of 700 GBq (19 Curie). Calculate the distance from the pipe you need to set barriers for a maximum dose rate of $7.5\mu\text{Sv/hr}$? (Source output = $130\mu\text{Sv/hr/GBq}$)
-

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 he or she has 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 39mm, the pipe outside diameter is 2m. If the barrier is 25m 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 $7.5\mu\text{Sv/hr}$?
- a) 80 metres

- b) 55 metres
- c) 8.0 metres
- d) 3.28 metres

DATA TO BE USED IN EXAMPLE CALCULATIONS

The following data will be used with all calculation questions:

Half value thicknesses:		Dose rates at 1 metre:		
Steel (Iridium)	13 mm	Iridium	$\mu\text{Sv/hr/GBq}$	130
Steel (Cobalt)	20 mm	Iridium	rem/hr/Ci	0.48
Steel (250 kV X-rays)	12 mm	Cobalt	$\mu\text{Sv/hr/GBq}$	357
Steel (200 kV X-rays)	6 mm	Cobalt	rem/hr/Ci	1.32
Lead (Cobalt)	11 mm	Ytterbium	$\mu\text{Sv/hr/GBq}$	33.8
Lead (Iridium)	5.5 mm	Ytterbium	rem/hr/Ci	0.125
Concrete (Iridium)	43 mm	Thulium	$\mu\text{Sv/hr/GBq}$	0.676
Concrete (Cobalt)	63 mm	Thulium	rem/hr/Ci	0.0025
Lead (Selenium)	1.5 mm	Selenium	$\mu\text{Sv/hr/GBq}$	55