# Changeroom Design, Operation and Maintenance

# A Nuclear Industry Code of Practice







This issue of the Nuclear Industry Code of Practice on Changeroom Design, Operation and Maintenance was published by the Industry Radiological Protection Co-ordination Group (IRPCG) on behalf of the Nuclear Industry Safety Directors Forum (SDF) in July 2006

The IRPCG recognises that, as use and experience of this Code of Practice grows, there may well be comments, questions and suggestions on the contents. IRPCG is committed to maintaining and updating the document the CoP so that it continues to represent good practice, and welcomes any such comments on the document.

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## Executive Summary

Changerooms, in one form or another, are associated with many practices involving the use of ionising radiation. As well as providing access to, and egress from, designated areas they also have a very important, and integral, role to play in preventing the spread of contamination. For this reason, it is important to ensure that the design, operation and maintenance of Changerooms reflects, so far as is reasonably practicable, agreed good practice.

Recently, both HSE/NII and the (Nuclear) Industry Radiological Protection Co-ordination Group (IRPCG), which is a working group set up by the Nuclear Industry's Safety Directors Forum (SDF), reviewed the approach to Changerooms across the nuclear industry. Both reviews found that there were a variety of approaches to the design, operation and maintenance of changerooms (although some differences are, of course, justifiable). It is also the case that relevant standards, guidance and so on had been extant for some time, and hence would benefit from review.

As a direct result, the IRPCG set up a sub-group consisting of relevant experts from member organisations with the following objective:

> "To develop an agreed good practice guide on changeroom design for use by the nuclear industry in the United Kingdom."

This Code of Practice is believed to be consistent with all relevant legislation and guidance, and has so far been endorsed by the following organisations:

- Atomic Weapons Establishment
- British Energy
- British Nuclear Group
- Devonport Management Ltd
- GE Healthcare Ltd
- Nirex
- Rolls-Royce
- United Kingdom Atomic Energy Authority

Operational and maintenance issues, insofar as they are relevant to changeroom design, were also to be covered. The guide was to take account of the different situations and radionuclides present across the industry, and identify the differences in changeroom design and operation that may result from these differences.

This Code of Practice has been the subject of extensive review and consultation amongst relevant stakeholders. However, as with any such document, publication may lead to a call for further advice, or for other aspects to be considered. The IRPCG will itself in future keep this CoP under review, and strongly encourages users to comment, ask questions or make suggestions on the content of this document. IRPCG undertakes to respond to any such comment in an appropriate manner and will revise and re-issue it as necessary. Membership of the IRPCG is included in Annex D, and contact information is given on the inside front cover of this document.

Finally, the IRPCG take this opportunity to thank all of the members of the Changeroom Working Group for the time and effort that they have put into producing this document.

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# 1 INTRODUCTION

In May 1984 the United Kingdom Atomic Energy Authority (UKAEA) issued Atomic Energy Code of Practice No.1003 (AECP 1003)[1] as a design standard for radiological changeroom facilities. This standard, like many other AECPs, was adopted for use by most of the main nuclear site operators at that time and by related organisations, including UKAEA, British Nuclear Fuels plc (BNFL), AWE plc, National Nuclear Corporation Limited (NNC) and the Central Electricity Generating Board (CEGB).

During the late-1980s and early-1990s there were many organisational changes amongst the nuclear operators that had previously co-operated in the production and application of AECPs. Hence when AECP 1003 was reviewed and revised by UKAEA (then operating under the name AEA Technology) in 1993[2], the document was credited as being produced only for AEA Technology use, although it is understood to have been available for application by some of the previous users. Other users developed their own specific design standards, subject to commercial constraints, and evolution of these documents has inevitably resulted in some diversity of changeroom design standards.

In recent years the Health and Safety Executive Nuclear Installations Inspectorate (HSE/NII) has noted this lack of commonality and has on occasion expressed concerns about particular aspects of changeroom design, construction or operation on certain nuclear sites. Consequently in 2002 the HSE/NII commissioned a report from an independent contractor reviewing good practice in the design and operation of nuclear changeroom facilities[3]. The intention of this review was to provide guidance suitable for use by all HSE staff involved in the inspection of changerooms giving access to radiological designated areas.

Nuclear site operators also recognised that not only were changeroom standards evolving, but that this could potentially give rise to significant differences between changerooms of different ages on the same site. Hence there was a requirement for an ongoing periodic review of changeroom standards, to ensure that consistent and adequate safety standards were maintained in all areas. This prompted an industry-wide review of changeroom practices concurrent with the HSE/NII review.

Following discussions between nuclear operators and the HSE/NII, a working group with input from the HSE/NII, was set up under the auspices of the Industry Radiological Protection Co-ordination Group (IRPCG). The objective of this group was to develop an agreed ‘Code of Practice’ on changeroom design, maintenance and operation for use by the nuclear industry in the United Kingdom. This Code of Practice is the product of the deliberations of the working group, and was published on behalf of the Safety Directors Forum in July 2006.

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# 2 APPLICATION

This Code of Practice is directly applicable to the design, operation and maintenance of new changerooms and those that are to be refurbished.

The effectiveness of existing changerooms will be periodically reviewed, for example as required by the Management of Health and Safety at Work Regulations 1999[4] or if an adverse occurrence (such as unexpected levels of contamination on people leaving a changeroom) is identified. This Code of Practice will be of use to dutyholders in such situations, although changes to existing changerooms for any reason will need to be justified and reasonable.

The issue of this Code of Practice is not intended to initiate wholesale review of existing changerooms where there is no driver to do so, such as those mentioned in the previous paragraph.

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# 3 SCOPE

This document details the systems, processes and features representing radiological protection good practice applied to all phases of the life of a new or newly refurbished changeroom. It is therefore relevant to design, construction, commissioning, operation and maintenance of such changerooms.

This document will be useful to all duty holders involved in the design, construction, commissioning, operation, maintenance and decommissioning of changerooms.

## 3.1 What is a changeroom?

For the purpose of this document a changeroom is a facility designed, constructed and operated to enable personnel to enter and leave potentially radiologically contaminated areas in a manner that confines, so far as reasonably practicable, the contamination inside the area and confirms, through radiological monitoring, that the personnel are not contaminated.

The changeroom offers an ideal location to implement access control to radiological designated areas.

In general terms the constituent parts of a changeroom are:

- Principal point(s) of access into (and egress from) the potentially contaminated area, including locations where clothing or equipment to protect against radiological hazards is donned or divested;
- An area adjacent in which personnel monitor and wash themselves; and
- An area for personnel to don (or to divest) clothing and personal effects, as appropriate.

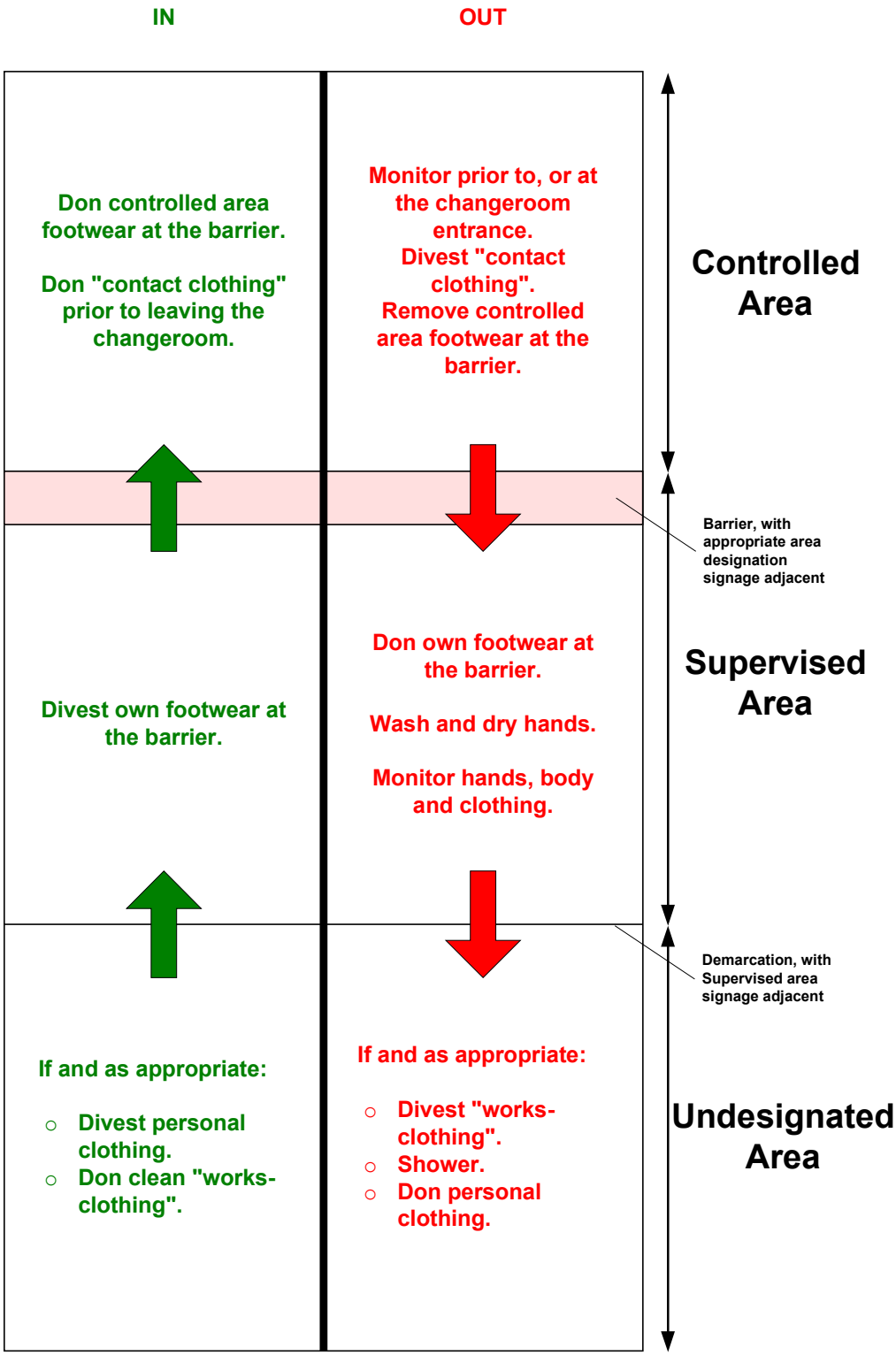
Normally these constituent parts will be located within a single facility (the changeroom), but this may not always be the case. Any deviations will be supported by a suitable and sufficient risk assessment that clearly justifies the adopted approach.

The changeroom serves as part of the overall contamination control arrangements associated with the potentially contaminated area. These arrangements enable demonstration of the adequacy and efficacy of contamination control.

A changeroom should not become contaminated and controls should be implemented downstream to ensure that it maintains its ‘clean area’ condition. Likewise contact clothing stored in a changeroom should not be contaminated and the overall contamination control arrangements should ensure this.

Figure 1 provides an overview of the sequence of steps involved in the good practice changeroom process. This figure also provides information that enables a better understanding of the functionality of the various sections of a changeroom and thus an appreciation of the good practice recommendations within this document.

Figure 1: Overview of Changeroom Process



### 3.2 Health and Safety legislation compliance

This document has been generated with consideration of relevant health and safety legislation. Where appropriate legislation has been referenced, but the primary legislations that have an influence on this document are:

- The Ionising Radiations Regulations 1999[5]. In particular Regulations 7 and 18 are the main focal points.
- The Management of Health and Safety at Work Regulations 1999[4].
- The Radioactive Substances Act 1993[6].
- The Workplace (Health, Safety and Welfare) Regulations 1992[7].
- The Health and Safety (Miscellaneous Amendments) Regulations 2002[8].
- The Provision and Use of Work Equipment Regulations 1998[9].
- The Personal Protective Equipment at Work Regulations 1992[10].
- The Personal Protective Equipment Regulations 2002[11].
- The Construction (Design and Management) Regulations 1994[12].

Section 8 details the primary compliance within this document with the Ionising Radiations Regulations 1999[5] requirements.

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# 4 MANAGEMENT AND SYSTEMS

## 4.1 Management

There should be an identified manager for each changeroom, with clearly defined resource and operational responsibilities, including upkeep, maintenance and supervision. Responsibilities for the management and control of any changeroom should be explicit and unambiguous.

Permanent supervision of operations within the changeroom should not necessarily be required, as all staff using the facility shall either be escorted or suitably qualified and experienced. Visitors will be escorted and it is incumbent on the escort to ensure that their visitor adopts appropriate protocols. It is, however, paramount that the condition of the changeroom and the practices of personnel within the area are audited on a regular basis. This auditing will provide an opportunity to identify issues requiring attention, review any events and breakdowns in control, and identify improvements to be addressed by the changeroom manager.

## 4.2 Risk assessment

A changeroom in support of facilities where unsealed radioactive materials are present must be supported by a suitable and sufficient risk assessment, as required under the Ionising Radiations Regulations 1999 (IRR99)[5] and the Management of Health and Safety at Work Regulations 1999[4]. Indeed the risk assessment process should be the starting point for the design of the overall contamination control process, of which the changeroom is but one part.

The risk assessment is fundamental to the safe design, operation and maintenance of changerooms serving areas where unsealed radioactive materials are present. Direct outputs from the risk assessment process will contribute to all of the following:

- Determination of the contamination control philosophy and the physical arrangement. This will include an assessment of the most appropriate split between on-facility controls / local monitoring and controls located at or within the changeroom.

- Appropriate area designation / categorisation signage for areas along the entrance / exit route(s).

- Contingency plans and emergency response arrangements, including non-radiological events, such as; fire, electrical power failure or equipment breakdown.

- Specification of arrangements for personal contamination monitoring should be specified explicitly in local rules.

- Routes of access / egress and monitoring arrangements for items generated within the contamination area.

- Identification of a 'finger print' of unsealed radionuclides, that can be used by the RPA to specify the type and sensitivity of personal contamination monitoring equipment and suitable Personal Protective Equipment (PPE) for personnel working.

### 4.3 Risk assessment for new build Changerooms

The prior risk assessment under IRR99[5] effectively requires the initial consideration of hazards and risks associated with the operation of the facility within which unsealed radioactive materials are handled. This assessment should include consideration of broad contamination control principles, such as application of the 'control at source' philosophy. This risk assessment will help identify the necessary contamination control arrangements, their physical location with regard to the potential source of contamination and the required degree of duplication of controls.

An important issue at this stage is the degree of 'nesting' of areas that may be subject to different control arrangements. For low-hazard, low-risk tasks a single barrier with adjacent hand-washing facilities and monitoring equipment may be entirely appropriate. Facilities with a greater contamination hazard will have the potential to present a more significant challenge to the changeroom and to its associated contamination-control measures. This may be offset by the introduction of additional contamination control procedures local to the facility, such as 'sub-change' barriers close to identified high-hazard work areas, often located where additional personal protective equipment must be worn. Local contamination control measures, for example 'frisking' with a contamination probe or use of an installed exit contamination detector, will also be appropriate at the exit from a facility that is remote from the nearest main changeroom.

In addition to the risk assessment addressing overall contamination control principles and arrangements, there should also be a comprehensive assessment of the hazards and risks relevant to the design and operation of the changeroom. This will include consideration of changeroom specific hazards and external hazards from supported facilities, for example:

- The chemical nature and physical form of radioactive contamination.
- The isotopic composition of materials likely to give rise to radioactive contamination.
- The quantity (activity) of radioactive material that could credibly be encountered.

### 4.4 Restriction of exposure

IRR99[5] requires that restriction of exposure, or application of the ALARP (as low as reasonably practicable) philosophy, should be applied to all work-related activities involving exposure to ionising radiations. ALARP considerations must therefore be applied to the design, operation, maintenance and decommissioning of changeroom facilities. As specified in 'Work with ionising radiation'[13], application of the ALARP principle involves consideration of the use of engineering controls and design features, operational controls (for example safe systems of work) and personal protective equipment, in that order of priority.

Changeroom features influenced by the application of engineering controls include:

- Location of the changeroom itself (to avoid high radiation levels).
- Where appropriate and practicable, the demarcation by physical segregation of ingress and egress routes.
- The changerooms 'Lifecycle' considerations, such as its size in relation to the current work programme, future expansion in work programme and the reasonably foreseeable decommissioning requirements of supported plants.
- Ergonomic designs of the storage arrangements for clean and used PPE, further information is provided in section 5.3.
- Use of physical barriers to demarcate potentially contaminated areas.
- Use of automated monitoring (for people and articles) and access control equipment to ensure appropriate controls at key points (where appropriate).
- Use of ventilation systems to control airborne activity.
- Surface coatings that are easy to decontaminate.

Operational controls include the:

- Radiological designation of areas.
- Application of radiological monitoring regimes.
- Format and application of local rules.
- Adoption of maintenance and inspection regimes specific to the changeroom.
- Provision of information to changeroom users, such as instructions, notices and signs.

Use of contact clothing, including PPE that conform to EC test standards, is an integral part of changeroom arrangements, for example the use of coveralls or lab-coats, shoes/overshoes, hard hats, gloves and waterproof clothing, if required.

### 4.5 Radiological surveys

Radiological conditions within changerooms must be kept under review in order to ensure safe operation and to detect any breakdowns in contamination control. All parts of the changeroom should be included in a schedule of routine radiological surveys, including adjacent non-designated areas, to verify that the areas remain correctly designated and to detect breakdowns in controls, systems and procedures. This would demonstrate the effectiveness of contamination control procedures and the absence of significant radiological risk.

The frequency and type of survey should be determined in consultation between the changeroom manager and the relevant RPA. The risks and consequences of contamination events and the historic record of detection, such as recent survey records and contamination incidents, are factors to be considered as part of this consultation.

Any survey schedule should indicate not only the area to be monitored and the frequency of survey, but also how the monitoring is to be undertaken, what monitoring instruments are to be used and what action levels are to be applied.

As a general guide, the following bullet list will reflect the ranking of survey frequency requirements, with the top of the list requiring the most frequent monitoring:

- Contamination control barriers and adjacent floor areas.
- Active-area footwear stored at the barrier.
- Other contact clothing used in controlled areas.
- 'Works Clothing' worn in controlled areas for contamination.
- Installed personal monitoring instrumentation.
- Remaining washing / monitoring areas.
- Clothing change areas and other nominally 'clean' areas.

Any requirement to monitor airborne activity levels should be determined initially from consideration of the radiological risk assessment supporting the changeroom operation. It is possible, if a changeroom is to be used for re-entry operations in the event of a facility emergency, that airborne activity monitoring will be required specifically to cover those operations even if not normally required for routine changeroom use. Appropriate emergency monitoring facilities would therefore need to be available. The frequency of radiation and contamination surveys would also need to be increased during an emergency.

### 4.6 Contingency plans

The prior risk assessment should identify credible radiation accident scenarios that can be used as the basis for contingency plans. Contingency plans specific to the changeroom facility will normally deal with reasonably foreseeable events, such as personal or surface contamination within the changeroom facility, possibly including the spill / spread of radioactive material. However, consideration also needs to be given to the role of the changeroom as a means of access to / egress from other operational facilities.

The changeroom should be equipped to deal with all reasonably foreseeable events associated with its normal operation. Radiological events to be addressed would include significant personal contamination, possibly affecting several changeroom users. For changerooms with a large number of users, and particularly those serving areas with an elevated risk of contamination, there should be decontamination facilities readily available, such as showers on the controlled area side of the changeroom, or arrangements to transfer personnel to a remote facility.

It would be good practice for contingency plans to include arrangements for retrospective monitoring of personnel and items that leave contamination controlled areas following an unplanned evacuation from the changeroom, not using normal egress routes and arrangements.

### 4.7 Radioactive clearance criteria

Monitoring and radioactive clearance control measures must be applied to all items leaving potentially contaminated areas to ensure that they are either treated as radioactive waste or can be declared as clean or exempt material[14]. It is not good practice for clearance and exemption monitoring of such items to take place in the changeroom, and this type of monitoring should take place in a facility that is physically separated from the changeroom.

There will be some non-clothing items such as pens, small notebooks, etc., for which equivalent procedures can be devised and included in the local rules. However, there needs to be clear identification or definition of the types of materials and objects that are appropriate for self-monitoring clearance by the owner/user.

Waste minimisation is an important consideration and good practice is for this to be dealt with at source, by minimising the quantity of materials entering potentially contaminated areas. There should be justification for items entering a potentially contaminated area and quantities must be controlled. Limitations should be placed on the passage of items through changerooms. There is some overlap between this topic and that of security restrictions and access control (please refer to section 6.1).

Changeroom users and their personal clothing, which may include 'Works Clothing', will be cleared from potentially contaminated areas via a standard changeroom procedure. Arrangements for used contact clothing and PPE should be specified, with a view to appropriate clearance procedures.

Guidance on clearance and exemption issues can be obtained from the relevant Nuclear Industry Code of Practice[14].

### 4.8 Location and site-wide co-ordination

It is good practice to contain and control radioactive contamination as close as possible to the point of origin. Changerooms form part of the overall contamination control regime and therefore should be located as close as practicable to the source facility or facilities. The need for outside areas to be designated as controlled should be minimised so far as reasonably practicable.

This said, on sites containing large numbers of facilities handling radioactive materials there may be some merit in co-ordinating changeroom arrangements to ensure consistency in procedures for users. Larger, well-used changerooms are more likely to justify adoption of good practice elements that may be expensive to implement, but this must be compared with the increased risks posed by the distance travelled from the source to the changeroom.

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# 5 DESIGN PROCESS

## 5.1 Fundamental considerations

The construction and fabric of the changeroom must as a minimum comply with the current Building Regulations Approved Documents and all relevant codes and standards. Consideration should also be given to the requirements of the Disabled Act (DDA) and BS8300. These requirements should be addressed within the criteria of the design where possible or through the Access Management Strategy Document.

Welfare requirements, such as toilets, etc., are covered by the Workplace (Health, Safety and Welfare) Regulations 1992[7] and it is expected that a future issue of this Code of Practice will contain an appendix providing greater information on design considerations.

## 5.2 Consultation

The designer of any changeroom should enter into consultation with the following interested parties during the design process:

- Employer and, where appropriate, the radiation employer.
- Changeroom Manager (who may be the employer / radiation employer).
- Radiation protection adviser (RPA).
- Operational Health Physicist.
- Changeroom staff.
- Users.
- Safety representative.
- Safety adviser.
- Fire officer.
- Maintainer.

The purpose of these consultations should be to ensure that there is a common understanding of the role of the changeroom and how it is to be used. Since the employer/radiation employer who becomes the changeroom owner will have duties under health and safety legislation, it may be sensible for them to conduct the liaison and consultation on behalf of the designer. Early input from a RPA is important with regard to legal compliance and radiation protection matters. All relevant legislative requirements and good practice issues should be addressed. Critical information to be incorporated into the design specification should include relevant summary details of the facilities served by the changeroom and the operations carried out within those facilities.

Other key items of information will include the number of users and patterns of usage, accommodation for changeroom support staff, ancillary functions of the changeroom, established practices in other changerooms on the same site and any known historic issues or information that may have a bearing on the future operation of the changeroom. Other parties who may need to be consulted and whose views may influence radiological protection arrangements include:

- Regulators.
- Security personnel.
- Emergency planner.
- Medical advisers.
- Clothing supply and laundry staff.
- Human factors and ergonomics specialists.

### 5.3 Use

Close attention should be paid to the sequential procedures that users are expected to follow and to any ways in which the layout of changerooms can facilitate this process. The objective is total compliance with specified procedures, thereby minimising the potential for adverse events, such as a spread of contamination beyond the boundary of radiological designated areas. The physical layout of the changeroom should enable a smooth progression through the various stages of the entry and exit procedure. This should be supported by information, instruction and training to enable changeroom users to understand exactly what they should do and why they should do it that way.

The procedures to be followed on crossing the boundary from a controlled area into an uncontrolled area are of key importance in minimising the risk of spread of contamination and are addressed in section 6.9.

### 5.4 Maintenance

Maintenance requirements should be identified during the design process. The maintenance requirements will necessitate input from specialist engineering personnel and from the RPA for those parts of the changeroom infrastructure that support contamination control and monitoring arrangements.

Maintenance activities should be optimised with other risks during the design process. For example, in a high contamination risk changeroom it may not be appropriate to have easily accessible pipe work that might become, or present a contamination trap hazard, whilst for a lower contamination risk changeroom this may be the optimum layout to facilitate access.

Cleaning should be regarded as a key part of changeroom maintenance and an opportunity to identify any deterioration of surfaces or the accumulation of dust, etc. in unexpected locations.

A suitable audit and inspection regime should be devised and implemented by the changeroom manager, that ensures that the changeroom remains fit for purpose and that it is being adequately maintained.

### 5.5 Liquid effluent handling and disposal

Liquid effluent should be discharged via an appropriate waste stream. Effluent from decontamination should be discharged via an appropriate active waste route. Waste from hand washing, undertaken following monitoring, should be disposed of via a suitable waste route (dependent upon potential activity). This process maybe subject to regulation in accordance with the Radioactive Substances Act 1993 (RSA93)[6] and requires consultation with either the Environment Agency (EA) in England and Wales, or the Scottish Environment Protection Agency (SEPA) in Scotland.

### 5.6 Variations from identified Good Practice

There is no need to have separate male and female changerooms, unless there are specific privacy considerations. All changerooms should conform to the good practice detailed in this document, or have a suitable and sufficient risk assessment in place that justifies the variance.

It is important to consider arrangements for any personnel covered by the Disability Discrimination Act 2002, but as these can be diverse they are not discussed further here. It is, however, important that a suitable and sufficient risk assessment identifying that the radiological risk remains tolerable supports any non-compliance issues caused by these arrangements. The RPA should be consulted on the appropriateness of any deviations from the stated good practice in this document.

Any other variations from the Good Practice identified within this document should be justified, discussed with the RPA and supported by suitable and sufficient risk assessment.

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# 6 FEATURES

## 6.1 Ingress and egress control

Employers who designate radiological controlled areas must restrict access to such areas, in a way that prevents unauthorised persons from entering. Changerooms are usually closely associated with access control arrangements, containing as they do the principal location for ingress and egress into areas controlled for contamination. Hence in the design of new changeroom facilities, there should be close liaison between the designer and the employer to agree the extent to which ingress and egress control arrangements are incorporated into the changeroom design.

Access controls may include the installation of pass-reader identity security turnstiles or similar arrangements. Other security requirements may also apply to certain controlled areas and it may be administratively convenient to co-locate additional security features within the changeroom layout. Modern electronic dosimetry systems, linked to turnstiles or similar infrastructure, can provide a convenient means of ensuring that persons entering a controlled area are subject to appropriate dosimetry arrangements and are approved to enter such an area.

Access control arrangements should ensure that persons entering controlled areas through the changeroom are either classified persons, or entering the area in accordance with suitable written arrangements. All persons entering controlled areas must have received adequate information, instruction and training, and be subject to a suitable means of dose assessment or restriction. It is good practice to restrict the number of ingress points to a controlled area to the minimum that is absolutely necessary, with the ideal being one, and to ensure that ingress is appropriately controlled at all points.

Where the controlled area is designated because of a contamination hazard, engineered devices should be used, where practicable, to prevent contaminated persons leaving the changeroom without decontamination and the initiation of an investigation into the circumstances.

Modern installed personal contamination monitoring equipment has the ability to identify a user from their issued dosimetry or a pass. If a safe alternative evacuation point within a controlled area is not available, manual overrides must be available to permit unrestricted exit in an emergency.

An alternative to the imposition of physical / mechanical interlocks is the application of supervision to the changeroom process. The rigour and effectiveness of supervisory control is difficult to quantify and is subject to human lapses, hence the adoption of interlocks is good practice. In summary for higher hazard facilities good practice would be electronic interlock arrangements, whilst for lower hazard areas this may not necessarily be justified. Good practice for larger throughput changerooms is the use of electronic access control.

## 6.2 Ventilation

If a changeroom supports a controlled area for contamination, ventilation is a key consideration. The risk assessment will assist in the identification of credible radiological exposure scenarios from airborne radioactive contamination. The requirement is to ensure that there is minimal risk of committed effective doses in the changeroom. It should also be borne in mind, that as the changeroom is connected to a plant with a ventilation system, there may already be suitable ventilation available.

Ventilation can be one of the means by which people outside a controlled area for contamination are protected from its spread. A key principle of the ventilation system, therefore, should be to move potentially contaminated air from lower to higher risk areas, that is, from the non-controlled area to the supervised area and then into the controlled area. If there is a risk of significant committed effective doses within the changeroom, then equipment to monitor levels of airborne radioactivity that alarms if set levels are exceeded should be considered, as well as a ventilation system. Sometimes ventilation is necessary to maintain the effectiveness of alpha-in-air monitoring (which would otherwise be adversely affected by high levels of radon and its daughters) and reduce the radon hazard.

Any ventilation system should be designed in accordance with a relevant technical design standard addressing the ventilation of radioactive areas. Where practicable, there should be some indication of the operational status of the ventilation system sufficient to warn users if the system is operating below its design specification.

A consideration linked to the use of ventilation systems is the routing of air extracted from controlled areas and its eventual discharge into the environment. This process is subject to regulation in accordance with the Radioactive Substances Act 1993 (RSA93)[6] and may require consultation with either the Environment Agency (EA) in England and Wales, or the Scottish Environment Protection Agency (SEPA) in Scotland.

## 6.3 Clothing and PPE

### *6.3.1 Issue of PPE*

For the purpose of this document, PPE refers to protective clothing or equipment, including respiratory protective equipment (RPE), designed to protect the user against radiological or conventional safety hazards.

All PPE should comply and be used in accordance with the Personal Protective Equipment at Work Regulations 1992[10] and the Personal Protective Equipment Regulations 2002[11].

PPE (including RPE) must be appropriately stored in a location that is easily accessible, but secure from unauthorised persons. Additionally, the issue of PPE should be controlled such that all persons using the equipment are suitably qualified and experienced persons (SQEP) in its use. The storage arrangements should protect the items from harmful effects such as physical damage, excessive heat, cold and moisture. There is a requirement for clear segregation of PPE into ready for use, used and defective.

The changeroom should have appropriate storage facilities, for the adequate supply of readily required PPE. It should, however, be noted that it is not the primary function of the changeroom to be a PPE storage and issue location. Certain operators may decide to adopt the changeroom for this purpose.

### *6.3.2 Respiratory Protective Equipment*

RPE must be safely stored in accordance with the manufacturer's instructions and in a way that prevents it becoming cross-contaminated. Guidance on RPE may be found in HSE's HSG53 - The selection, use and maintenance of respiratory protective equipment[15].

### *6.3.3 Clothing and PPE storage*

It is important that coveralls/laboratory coats remain in an uncontaminated condition and that they should be deposited in dedicated bins when they need to enter the cleaning cycle. Storage arrangements will need to take due account of the particular work environment, but used contact clothing, including PPE, should be stored on the controlled area side of the barrier within a short distance of the barrier. Coveralls/laboratory coats on the controlled side of the barrier should be stored on hooks, with adequate adjacent space to reduce the risk of cross contamination from neighbouring coveralls. Only one coverall/laboratory coat should be stored at the hook location and all reasonably practicable steps must be implemented to inhibit the internals of the coverall becoming contaminated, such as fastening the coverall after use. If hard hats are to be used in the area supported by the changeroom, a sufficient number of hooks should be provided and only one hard hat should be stored at each hook location in the changeroom. Shoes for use in the controlled area should be stored within pigeonholes that are integrated into the barrier; there should also be storage locations on the non-controlled side of the barrier for storage of personal footwear.

Other types of contact clothing will be determined on a case by case basis, following a suitable and sufficient risk assessment for particular facilities or areas to be entered. These items fall outside the normal scope of equipment held within a changeroom. Single-use items do not require storage facilities at the barrier, but will require disposal facilities (bins). Items that can be re-used must have appropriate dedicated storage facilities and where practicable, enable the user to be easily identified in the event of contamination being found. Identified routes for dealing with damaged reusable PPE should be available, so that the PPE can be repaired or disposed of as appropriate. Separate storage facilities should be provided for disposal of contaminated clothing or PPE (please refer to section 6.7).

### *6.3.4 Storage of outdoor and personal items / clothing*

Lockers should be provided in clothing change areas for secure storage of personal clothing and effects. Monitoring and clearance procedures for persons leaving the barrier/monitoring area should be sufficiently robust that the provision of separate lockers for personal clothing and for used 'Works Clothing' is unnecessary.

Adjacent to external doors, a changeroom should incorporate facilities for the hanging and drying of outdoor clothing, including 'Works Clothing' where appropriate.

### 6.4 Information, instruction and signs

Local Rules, compliant with the requirements of the IRR99[5] must be posted at prominent locations within the changeroom, or at its entrance, and should include ingress and egress procedures.

Clear signage should also be displayed in the changeroom that includes:

- The radiological designation of the area.
- Sequence of steps to progress in and out of the changeroom.
- Key steps in the barrier procedure for entry into and exit from any controlled area. Examples are shown in Annex B.
- Use of monitoring equipment and actions in the event of an alarm or malfunction.
- Contacts if assistance is required.

It is good practice to use pictorial signs, where feasible, as these are particularly useful in illustrating sequential procedures such as clothing divestment and barrier crossing. Specialised monitoring equipment is available that utilise synthesised voice messaging, to issue audible instructions to users. Alarm signals should be both audible and distinct, with users trained in their recognition. It is also good practice for training in barrier procedures (that is dressing, undressing, washing and monitoring) to be included in induction training.

Specific signs detailing emergency arrangements may be appropriate in addition to the summary details incorporated into the local rules.

### 6.5 Controlled area delineation / demarcation (barriers)

A physical barrier (which identifies a step change in the level of risk) should be used to demarcate controlled areas, especially those designated for a contamination hazard. Non-physical demarcation is not good practice for areas designated as controlled for contamination, but may be appropriate for areas designated for a radiation hazard, when supported by a suitable and sufficient risk assessment and consultation with a RPA.

Where reasonably practicable, changeroom facilities should incorporate a physical barrier extending down to ground level delineating the outer boundary of the controlled area. A barrier should fully cover the length of any controlled area boundary.

If the barrier forms part of an emergency exit, the barrier shall comply with all requirements of relevant fire safety legislation, on which the Fire Officer should be consulted. The physical dimensions of the barrier should be such that a person could not credibly step over it without meaning to do so. At locations where personnel enter or leave the controlled area, the barrier should be suitable for workers to sit on, to don and divest protective footwear. The top of the barrier shall have the same radiological designation as the floor on the ‘clean’ side of that barrier.

The combination of barrier and associated signs should indicate clearly and unambiguously

the extent of the controlled area. The area on the 'clean' side of the main barrier should be designated as a supervised area and the conditions kept under review. The extent of the supervised area should be clearly delineated by signs and notices.

### 6.6 Materials of construction

Changerooms, in common with other areas associated with the handling and processing of radioactive material, should have engineered and administrative controls in place that ensure, so far as is reasonably practicable, that the surfaces do not become contaminated with radioactive materials. It is still reasonably foreseeable that a changeroom may become contaminated and require decontamination. BS4247-1: 1981[16] and BS4247-2: 1982[17] provide guidance on the methods of evaluating and ascertaining the decontamination factor of a surface and guidance on the selection of materials for use in radioactive areas respectively.

These principles are illustrated through their application to the role of a barrier, a key component of the changeroom furniture. Any barrier shall be constructed:

- Of a material suitable to withstand the weight and structural stresses to be exerted on it, during reasonably foreseeable usage.

- So far as reasonably practicable with radial corners and edges to minimise the potential build up of radioactive contamination.

- Coated in, or constructed of a material that offers a continuous impermeable membrane that is resistant to damage, such as scratches breaching the membrane.

- Such that all surfaces are smooth, with no significant surface imperfection that may act as potential contamination traps. The membrane shall, if damaged, not offer a porous surface to potential contamination.

- So that it is appropriately sealed to the building fabric, to restrict the migration of radioactive contamination. All surfaces of the barrier must be easily decontaminated and resistant to damage when cleaned utilising standard industrial cleaning chemicals. Suitable materials are given BS4247-2: 1982[17].

- So that it offers no sharp or jagged edges that may pose a cutting or puncture hazard to personnel crossing or coming into contact with them. Joints and junctures should be minimised and appropriately sealed, to inhibit contamination migration.

Another key changeroom structure of particular importance to contamination control is the floor surface, which should be smooth with sealed joints to prevent ingress of contamination and with an upward curving lip in corners and along edges. Floor surfaces should, however, provide sufficient grip when wet or dry to mitigate against the risk of slipping.

### 6.7 Laundry bins

Bins used for the collection of used contact clothing should be designed to facilitate easy monitoring and decontamination. The use of readily identifiable bins, such as colour-coded, is good practice. All such bins should be marked externally to indicate their contents or intended use. Bins should be lined with bags designed for the receipt and onward handling of their contents. Bins for contact clothing should be included on the routine survey schedule, along with the contact clothing.

Changeroom working instructions will normally include arrangements for the monitoring and handling of all types of laundry.

### 6.8 Communications

Changerooms should be equipped with communication systems accessible from each main area, including from both sides of the main contamination-control barrier. At each communication point, key contacts should be posted to enable assistance to be summoned if required.

### 6.9 Personal contamination control

Fundamental contamination control arrangements are those associated with the barrier procedure for personnel access to and from the controlled area. The good practice barrier area layout involves a single shoe-change barrier with clean clothing and shoe storage on one side of the barrier and coveralls, active-area shoes and PPE stored and left after use on the controlled-side of the same barrier (as shown in Annex A).

Washing and monitoring facilities should be housed in a supervised area. Procedures should aim to further reduce the risk of transferring radiological contamination beyond the boundary of the supervised areas and into undesignated areas. After physically crossing any contamination control barrier, and up to the point where personal contamination monitoring is completed, there remains a risk of a transfer of contamination into the washing and monitoring area. Therefore the radiological conditions within such an area should be monitored and kept under review in order to minimise any associated doses received by persons working in, or passing through, this area.

As shown in Figure 1, the process is monitor local to work area and on route if appropriate, wash hands and monitor within the changeroom. All instances of personal contamination must be reported immediately, this is to ensure that the cause can be investigated and so that appropriate decontamination arrangements implemented. This arrangement is of benefit to the contaminated person and other personnel if the contamination is identified early and appropriately controlled.

### 6.10 Personal decontamination facilities

Decontamination facilities should be available for the use of persons found contaminated either in, or on the approach to, changerooms. Decontamination should only be conducted by, or under the guidance of suitably trained personnel. Use of such facilities must be supervised, and arrangements for access posted. If decontamination facilities are not readily available, alternative arrangements should be identified in local instructions and included in local rules.

The precise nature of decontamination facilities will be determined from the outputs of the changeroom risk assessment and will be agreed between local management and the RPA. Detailed arrangements may be influenced by the facilities that the changeroom serves and the type and quantity of radioactive contamination that may be presented at the changeroom. Facilities handling small quantities of radioactive materials in known configurations may require little more than a single washbasin, some soap or other detergents and a cloth or other means of application. Abrasive or corrosive decontamination agents should not be readily accessible and should only be used by personnel trained in their use.

Changerooms serving more substantial facilities, with an associated risk of widespread personal contamination and perhaps with a larger number of users, may warrant dedicated shower facilities for supported decontamination following unplanned events. The showers should be supported by a suitable and sufficient risk assessment, and housed within an enclosure constructed to limit the spread of radioactive contamination. Ideally the water supply to such a shower should be thermostatically controlled, and the waste must go through an active route.

Drying and monitoring facilities should be provided locally, together with replacement clothing for use after decontamination. Appropriate storage should be provided for any cleaning or decontamination agents and personnel should be trained in their use. Decontamination procedures should be specified which minimise the risk of inducing or aggravating any damage to the skin that may result in the bodily ingestion of radioactive contamination.

Where decontamination is carried out in a facility remote from the changeroom, clean protective clothing and materials suitable to cover contaminated areas must be provided locally to facilitate the transfer of contaminated persons to that facility.

Effluent from decontamination practices should be treated as potentially radioactive waste and dealt with appropriately through an active route.

If personal decontamination is to be conducted in the changeroom, it would be good practice to install modesty facilities.

### 6.11 Washing / drying facilities

Washing and drying facilities must be located as close as practicable to the main contamination control / barrier area. For most purposes an adequate degree of radiological control can be ensured through the provision and use of hand washbasins, with running warm water. Washbasins must be capable of operation without using the hands and ideally the water supply should be thermostatically controlled.

Associated soap dispensing facilities that minimise the risk of cross-contamination should be used.

If prior monitoring arrangements are in place to control the risk of discharging radioactive material through this route, liquid effluent from hand washbasins should be disposed of via a suitable waste route.

This process is subject to regulation in accordance with the Radioactive Substances Act 1993 (RSA93)[6] and may require consultation with either the Environment Agency (EA) in England and Wales, or the Scottish Environment Protection Agency (SEPA) in Scotland.

Hot-air hand dryers are considered good practice, from a radiological protection standpoint, for drying hands. Decisions on the location of the hot-air hand dryers should take due cognisance of any potential for re-suspending contamination on the potentially contaminated side of the barrier. Contingency arrangements should be in place to support a power supply or equipment failure, such as a supply of disposable paper towels. Where alpha contamination of hands is a possibility, it is important that the hands are dried effectively before employing any subsequent monitoring techniques.

## 6.12 Monitoring facilities

### *6.12.1 Purpose*

Monitoring serves the dual purpose of identifying radioactive contamination above defined control levels and providing an indication of a breakdown of either facility-based, or changeroom-specific controls (such as cross-contamination).

### *6.12.2 Pre-changeroom monitoring*

Where comprehensive on-facility monitoring is impracticable, or greater control is required before entering the changeroom, it is good practice to include a monitoring stage as part of the changeroom entry procedure. Such a requirement should be identified from the changeroom risk assessment and consideration of the credible range of hazards associated with facilities served by that changeroom. This monitoring should focus on the detection of personal contamination associated with facility operations and might be as simple as using a frisking probe. The monitoring arrangements should be set up to give an alarm signal above a pre-defined contamination action level. Local arrangements must include a means of summoning assistance in the event of an alarm and the recording of relevant details.

In some situations where exposure through contamination by high-activity beta/gamma particulate activity is a significant risk, it may be appropriate to install exit-type ‘walk-through’ monitoring equipment to automate the pre-changeroom monitoring process. Alarm signals and the appropriate response would need to be incorporated into local instructions and user training.

*6.12.3 Barrier or boundary monitoring*

All changerooms servicing areas designated for a contamination hazard, must incorporate a means of personal contamination monitoring on the 'clean' side of any contamination control barrier, denoting the effective boundary between a contamination supervised area and an undesignated area. Personal contamination monitoring equipment should be located adjacent to any hand washbasins, in the supervised area, that persons who have left the controlled area are required to use.

Where a working area has been designated only as a contamination supervised area and no controlled area has been designated, exit arrangements from the supervised area would normally include the use of personal contamination monitoring equipment.

*6.12.4 Equipment specification and use*

The detailed technical specification of contamination monitoring equipment used in changerooms should be derived from the changeroom risk assessment and from detailed consideration of the credible range of radiological hazards associated with the facilities served by the changeroom.

Monitoring equipment should be capable of detecting significant quantities of any radionuclide that may pose a credible contamination risk in areas served by the changeroom. The determination of a significant quantity of any radionuclide should include consideration of clearance and exemption requirements[14] as well as normal radiological protection issues such as radiation doses and application of the ALARP principle. The presence of radionuclides that are not detectable by available changeroom monitoring equipment may be inferred from measurements of other radionuclides, where there is a reasonably constant radionuclide mix ('fingerprint') and relevant detection thresholds provide an appropriate level of radiation protection.

Action levels should be derived for all types of monitoring equipment used in changerooms and for all anticipated modes of use. Where practicable, the monitoring equipment should be set up to alarm if contamination above the defined action level is detected. Action levels should, as a minimum, be based on, or derived from, surface contamination clearance values applied to items leaving contamination controlled areas[14]. Current standard values for the United Kingdom nuclear industry are 0.4 $Bq/cm^2$ for high toxicity alpha emitters and 4.0 $Bq/cm^2$ for beta/gamma emitters.

Where practicable, it is considered good practice to adopt lower values for action levels on monitoring equipment, so long as the risk of false alarms is optimised. This is justified on the basis of maintaining radiological risks at a level that is as low as reasonably practicable (ALARP). Dedicated hand monitors located in low background radiation fields may be capable of operating with an alarm level set at one-tenth of the previously stated controlled area surface contamination clearance values.

There should be a written statement of action levels for each type of monitoring equipment used in a changeroom including, where practicable, the derivation of those action levels. Additionally there should be a written record indicating the reasoning behind the use of the selected combination of instruments in the exit monitoring process.

This should include formal consideration of the radionuclides likely to be encountered and how their presence is to be determined, whether measured directly or inferred from measurements of other radionuclides.

Monitoring regimes should be suitable for monitoring of the body. Each changeroom should have a defined exit-monitoring regime with associated instructions and user training. The use of installed monitoring equipment set up to ensure operation in a pre-determined monitor/user configuration is considered good practice where that configuration ensures an acceptable standard of monitoring.

Exit monitors, fitted with proximity alarms to ensure minimal separation between the monitored surface and the detector, are examples of such equipment. They may also be linked with access control facilities to prohibit the exit of contaminated personnel.

Floor-to-ceiling systems are also available that can restrict the passing of inanimate objects across to the undesignated side. It is worth noting that installed fixed-configuration monitoring equipment has significant limitations when it comes to the monitoring of alpha or low-energy beta contamination on clothing. A consistently small clothing-detector separation is often not practicable and hence such equipment should normally be used in conjunction with a hand-held contamination monitor such as a frisking probe (wall-mounted or stand-alone). The principle drawback of hand-held equipment is that its efficacy is entirely dependent on user skill and diligence.

Within a large, permanent, high-throughput changeroom it may be appropriate to use a combination of frisking probe to monitor body / clothing surfaces, followed by an automated exit monitor to detect hand and foot contamination. Generic guidance on the selection monitoring instrument combinations, based on technical and cost considerations, is as detailed below:

| Significant Radiation hazard | Monitoring arrangement | | |
|---|---|---|---|
| | Exit Monitor | Hand and Foot Monitor | Frisking Probe |
| Alpha, beta and gamma | ✓ | * | ✓ |
| Beta and gamma | ✓ | * | ✓ |
| Alpha only | X | ✓ | ✓ |
| Low energy beta | X | X | ✦ |

✓ Recommended
* Contingency
X Not recommended
✦ Only if designed for use with low energy radiation

The necessary quantity of monitoring equipment should be determined through consideration of likely peak throughput of persons exiting the changeroom. Some allowance should be made for typical rates of equipment non-availability associated with faults or routine calibration / maintenance. Special consideration may need to be given to emergencies when the need for urgent evacuation of personnel may justify a non-standard exit monitoring procedure, or the introduction of supplementary monitoring capabilities brought in from outside the changeroom.

The instructions to users of changeroom monitoring equipment should include specific arrangements for the recording of all alarms, other significant radiological findings and any unusual events, including equipment malfunctions. The training of changeroom users should emphasise the positive benefits from investigation of all such events and should thereby encourage the adoption of a "no blame" culture.

Low levels of contamination may build-up over time on monitoring equipment and this may increase detection thresholds and the number of missed contamination incidents on devices that do their own background radiation correction. Most modern portal monitors will raise an alarm when the background becomes too high. Foils / windows should be cleaned or replaced when they become significantly contaminated to reduce risks of contamination spread, so far as is reasonably practicable.

*6.12.5 Maintenance, testing and calibration*

All monitoring equipment must be subject to an appropriate testing and calibration regime. This regime should be derived after consultation with the employer's RPA and the qualified person under the Ionising Radiations Regulations 1999[5] who oversees the testing and calibration of monitoring equipment. Further guidance can be found in Measurement Good Practice Guide No. 30 - Practical Radiation Monitoring[18] .

## 6.13 Toilets

It is not good practice to have toilet facilities within potentially contaminated areas. Toilets should only be located in an area following final personnel monitoring. This ensures that any persons using the toilets after leaving a potentially contaminated, both supervised and controlled contamination, areas have monitored themselves and ascertained that they are free from detectable personal contamination.

## 6.14 Dosimetry facilities

It is not the primary function of a changeroom to support the issue and storage of personal dosimetry. Operators may decide that the changeroom is a suitable location for this and if this is so, they should have adequate provision for the storage of personal external dosimetry and issue/return/temporary storage of personal air samplers (PASs), as appropriate. Any external dosimetry stored within the changeroom must be stored in a location where the ambient dose rate is at or is close to normal background levels. Any dosemeter storage location should be such that the risk of damage or interference from environmental factors is negligible. For example, dosemeters should not be stored under pipework which might leak, or result in falling condensate. Training of personnel should inform them that dosimetry should not be left on contact clothing, which could then undergo washing or be discarded.

If dosimetry is to leave the controlled area, appropriate monitoring must be undertaken prior to its release.

Changerooms used for the issue of PASs, for the assessment of potential intakes of radioactive materials, must be designed to avoid cross-contamination of PASs, for example through direct contact with contaminated surfaces.

Arrangements for the issue, storage and handling of PASs must therefore be organised to avoid contact with potentially contaminated surfaces.

Internal dosimetry assessment regimes may require the provision of excreta samples (urine or faeces) by changeroom users either on a scheduled routine basis or as a one-off exercise in response to a suspected intake or potential exposure event. These samples should be provided in an area following final monitoring from the designated area, where there is no significant risk of environmental contamination in order to avoid potential cross-contamination of excreta samples. Local procedures for the provision of excreta samples must require the washing of hands both before and after sample provision to further minimise the risk of cross-contamination.

### 6.15 Sub-Changerooms

High contamination hazard facilities will have the potential to present a more significant challenge to the changeroom, its associated contamination-control measures and areas on-route to the changeroom. This should be counteracted by the introduction of additional contamination control procedures local to the facility, such as ‘sub-change’ barriers close to identified high-hazard work areas, located where additional personal protective equipment must be worn. At these locations personnel will remove and store contact clothing, and then don dedicated specific contact clothing before entry into the higher contamination hazard, by crossing a barrier. These items of contact clothing should be divested prior to returning over the sub-barrier. In certain operations, operators may require the assistance of an undresser to ensure the save egress of personnel. If this is likely in a sub-changeroom, its design should take this requirement into account. Local contamination control measures, for example independent monitoring by a health physics surveyor, or the use of an installed exit contamination detector, will also be appropriate at the entrance/exit from a facility that is geographically remote from the nearest main changeroom.

A risk assessment for the operation of this type of changeroom is particularly important due to the enhanced risk. Please refer to section 9.2 for more information.

There is a need for physical restriction to prevent inadvertent access to controlled areas having particularly high levels of external radiation, or contamination. This may include sub-change areas where a combination of lockout arrangements and positioning of physical barriers deter intruders. This issue is discussed further in section 5.1.

### 6.16 Remote changerooms

A remote changeroom is a changeroom operated remotely to the actual work area. Changerooms, for radiological protection purposes, utilised on a temporary basis, or in remote areas should follow the good practice recommendations contained within this document, so far as reasonably practicable. Any deviations from the practice detailed within this document should only occur when supported by a suitable and sufficient risk assessment, and following consultation with an RPA.

As far as reasonably practicable the use of transportable changerooms, equipped in line with this document should be considered for areas remote from suitable changeroom facilities.

If a task or project is likely to be undertaken frequently and/or over a protracted period, then suitable facilities in line with good practice should be installed.

If suitable facilities are not available, either within a building or transportable, then the guidance within this document should be adopted, so far as reasonably practicable, with particular attention being paid to the following issues:

- The hazards posed by the work (including changing and contingency arrangements) and how the risks can be reduced to a level that is as low as reasonably practicable.
- Security of access to the radiological designated area.
- Contamination control.
- Ventilation, either forced or natural.
- Clothing and PPE (including RPE) arrangements.
- Information, instruction and training provided to personnel.
- Delineation or demarcation of the area and signage.
- Storage of personal clothing.
- Materials used that may become contaminated.
- Appropriate waste disposal and storage arrangements.
- Contingency arrangements, including communication and decontamination arrangements.

Under certain circumstances it may be appropriate to utilise a suitable remote changeroom facility with a demarcated transit route to the work area, so long as the procedures are appropriately assessed, understood, managed, controlled and implemented. Local contamination control procedures must be rigorous and robust for personnel leaving the work site. This should include independent monitoring by a health physics surveyor and may include a change of footwear.

The area between the work site and the remote changeroom must be designated as supervised (or possibly controlled in certain circumstances), if contamination is a hazard, throughout the time of changeroom operation. The area should be returned to its original designation, only after a suitable radiological survey confirms that this appropriate and following RPA consultation.

### 6.17 Emergency response

It is not the primary function of a changeroom to act as an emergency response centre, but it may well be ideally located and suited to fulfil such a role. Thus the use of the changeroom in an emergency response role is discussed in general, rather than in any specific detail.

The changeroom may have a significant role to play in the response to an event in a facility it serves and this role would need to be addressed in the changeroom's emergency response arrangements. Facility- or site-specific emergency arrangements affecting the changeroom might include its use as a mustering point for evacuated personnel, for the triaging of those potentially affected by an on-facility event or as a control point for recovery operations. Hence, there needs to be co-operation between the changeroom and facility operators to integrate the respective emergency plans. One possible consequence of such considerations is that the changeroom may need to be equipped to act as a control point in the event of an emergency requiring evacuation of adjacent facilities.

The use of CCTV or similar equipment to give a picture of emergency response arrangements in the vicinity of the controlled area access barrier and the washing/monitoring facilities could be beneficial to persons directing emergency recovery operations from a remote location.

The CCTV monitors should only be operational during an emergency response (or emergency exercise), and be located and operated such that the personal privacy of members of the emergency response teams is not compromised. CCTV is not considered appropriate for most changerooms.

### 6.18 First Aid

Similarly it is not the primary function of a changeroom to act as a First Aid point, but in certain circumstances it may lend itself to being used for this function. If a changeroom is to be utilised for this role it would need to be clearly justified by a suitable and sufficient risk assessment, to ensure that other hazards are not exacerbated to enable this functionality.

It would be clearly inappropriate, under normal situations, to use the changeroom as anything more than a First Aid post and the treatment of wounds, etc., would be better serviced elsewhere.

# 7 SUMMARY OF KEY POINTS

- A changeroom should not become contaminated and controls should be implemented downstream to ensure that it maintains its 'clean area' condition. Likewise contact clothing stored in a changeroom should not be contaminated and the overall contamination control arrangements should ensure this.

- There should be an identified manager for each changeroom, with clearly defined resource and operational responsibilities, including upkeep, maintenance and supervision. Responsibilities for the management and control of any changeroom should be explicit and unambiguous.

- A changeroom in support of facilities where unsealed radioactive materials are present must be supported by a prior suitable and sufficient risk assessment, as required under the IRR99[5] and the Management of Health and Safety at Work Regulations 1999[4].

- The changeroom should be equipped to deal with all reasonably foreseeable events associated with its normal operation.

- The designer of any changeroom should ensure that there is consultation with interested parties during the design process. It may be sensible for the employer/radiation employer to conduct this liaison and consultation on behalf of the designer.

- Liquid effluent should be discharged via an appropriate waste stream. Effluent from decontamination should be discharged via an appropriate active waste route, whilst waste from hand washing undertaken following monitoring, should be disposed of via a suitable waste route.

- It is not good practice for clearance and exemption monitoring of other items to take place in the changeroom, and this type of monitoring should take place in a facility that is physically separated from the changeroom. There will be some non-clothing items such as pens, small notebooks, etc., for which equivalent procedures adopted in the changeroom can be devised and included in the local rules.

- If a changeroom supports a controlled area for contamination, ventilation is a key consideration. The ventilation system should move potentially contaminated air from lower to higher risk areas, that is from the non-controlled area to supervised area and then into the controlled area. The requirement is to ensure that there is minimal risk of committed effective doses in the changeroom.

- PPE (including RPE) must be appropriately stored in a location that is easily accessible, but secure from unauthorised persons.

- A physical barrier should be used to demarcate controlled areas, especially those designated for a contamination hazard. Non-physical demarcation is not good practice for areas designated as controlled for contamination, but may be appropriate for areas designated for a radiation hazard, when supported by a suitable and sufficient risk assessment and consultation with a RPA.

- Fundamental contamination control arrangements are those associated with the barrier procedure for personnel access to and from the controlled area.

- Washing and drying facilities must be located as close as practicable to the main contamination control / barrier area.

- Monitoring serves the dual purpose of identifying radioactive contamination above defined control levels and providing an indication of a breakdown of either facility-based, or changeroom-specific controls (such as cross-contamination).

- It is not good practice to have toilet facilities within potentially contaminated areas. Toilets should only be located in an area following final personnel monitoring. This ensures that any persons using the toilets after leaving a potentially contaminated area have monitored themselves and ascertained that they are free from detectable personal contamination.

- It is good practice to contain and control radioactive contamination as close as possible to the point of origin. Changerooms form part of the overall contamination control regime and therefore should be located as close as practicable to the source facility or facilities.

- Radiological conditions within changerooms must be kept under review in order to ensure safe operation and to detect any breakdowns in contamination control.

# 8 COMPLIANCE WITH THE IONISING RADIATIONS REGULATIONS 1999

The following table highlights the primary sections within this document where appropriate legislative requirements of the IRR99[5] are fulfilled within this document. Other sections of the document may also have a significant bearing on legislative compliance.

| **Regulation number** | Regulation | **Section of document** |
|---|---|---|
| **7** | Prior risk assessment etc. | • 4.2 Risk Assessment |
| **8** | Restriction of exposure | • 4.3 Restriction of exposure<br>• 6.2 Ventilation<br>• 6.9 Personal contamination control |
| **9** | Personal Protective Equipment | • 4.3 Restriction of exposure<br>• 6.3 Clothing and PPE storage |
| **10** | Maintenance and examination of engineering controls etc and personal protective equipment | • 4.3 Restriction of exposure<br>• 4.5 Contingency Plans |
| **12** | Contingency plans | • 4.2 Risk Assessment<br>• 4.5 Contingency Plans |
| **13** | Radiation protection adviser | • 5.2 Consultation |
| **14** | Information, instruction and training | • 5.2 Use<br>• 6.1 Ingress and egress control<br>• 6.4 Information, instruction and signs |
| **15** | Co-operation between employers | • 5.2 Consultation |
| **16** | Designation of controlled or supervised areas | • 6.5 Controlled area delineation / demarcation (barriers) |
| **17** | Local rules and radiation protection supervisors | • 6.4 Information, instruction and signs |

| | | |
|---|---|---|
| **18** | Additional requirements for designated areas | • 6.4 Information, instruction and signs<br>• 6.5 Controlled area delineation / demarcation (barriers)<br>• 6.9 Personal contamination control<br>• 6.11 Washing / drying facilities<br>• 6.12 Monitoring facilities<br>• 6.12.3 Barrier or boundary monitoring |
| **19** | Monitoring of designated areas | • 6.12.3 Barrier or boundary monitoring |

# 9 CHANGEROOM SCENARIOS AND ILLUSTRATION OF GOOD PRACTICE

The illustrative 'good practice' changeroom is shown in Annex A and discussed throughout this document. The suitability of this arrangement to particular circumstances should be verified by a suitable and sufficient risk assessment. All new and refurbished changerooms should be based on the information provided in this document, with any deviations being justified through a suitable and sufficient risk assessment.

Example issues for consideration in the risk assessment, for task specific changerooms are provided below.

## 9.1 Main Changeroom

For main changerooms supporting access and egress to and from areas designated as controlled for contamination.

| **Feature for consideration** | **Good Practice considerations** |
|---|---|
| Location and general layout | • Located close to facility areas to which access is to be gained.<br>• Consists of point of access (shoe/boot-change barrier) to/from contaminated area and associated monitoring facilities. |
| Security and access control | • Access limited to suitable qualified and experienced personnel. |
| Controlled area delineation / demarcation | • Applicable to an area of higher radiological risk (and usually area radiological designation) than the general area. |
| Contamination control arrangements | • PPE and outer clothing divested before crossing shoe/boot-change barrier.<br>• Radiological survey frequencies are derived from a suitable and sufficient risk assessment or from historic survey records. |
| Monitoring facilities | • Prior to entering the main changeroom from an active area:<br>• Frisking probe used by the worker to monitor all accessible parts of the body, including hands, arms, legs, ankles, feet, torso and head.<br>• Hand monitor available for use before leaving sub-change area.<br>Prior to exiting the supervised area:<br>• As discussed in section 6.12. |
| Provision, storage and handling of clothing / PPE | • Arrangements for use and storage of clothing and PPE worn on the elevated risk side of the sub-change barrier should enable the identification of the wearer of any item subsequently found contaminated. |

## 9.2 Sub-Changeroom

For sub-changeroom supporting access and egress to and from areas of higher risk facilities located remotely from the main changeroom.

| **Feature for consideration** | Good Practice considerations |
|---|---|
| Location and general layout | • Located close to facility areas to which access is to be gained.<br>• Consists of point of access (shoe/boot-change barrier) to/from area of potentially high contamination and associated monitoring facilities. |
| Security and access control | • Inaccessible when not in use.<br>• Access limited to trained personnel; usually with written authorisation to undertake work. |
| Controlled area delineation / demarcation | • Applicable to an area of higher radiological risk (and usually area radiological designation) than the general area. |
| Contamination control arrangements | • PPE and outer clothing divested before crossing shoe/boot-change barrier.<br>• Radiological survey frequencies are derived from a suitable and sufficient risk assessment or from historic survey records. |
| Monitoring facilities | • Frisking probe used by all personnel to monitor discarded contact clothing.<br>• Frisking probe then used by the worker to monitor all accessible parts of the body, including hands, arms, legs, ankles, feet, torso and head.<br>• Hand monitor available for use before leaving sub-change area.<br>• Arrangements are defined for the recording and reporting of all findings of personal contamination above instrument alarm / action levels.<br>• Local contamination control measures, for example independent monitoring by a health physics surveyor, or the use of an installed exit contamination detector, will also be appropriate at the entrance/exit from a facility that is geographically remote from the nearest main changeroom. |
| Provision, storage and handling of clothing / PPE | • Arrangements for use and storage of clothing and PPE worn on the elevated risk side of the sub-change barrier should enable the identification of the wearer of any item subsequently found contaminated. |
| Ventilation | • The increased contamination risk at the sub-change barrier means that ventilation is required. |

### 9.3 Reactor Changeroom

Changerooms associated with operational nuclear reactors necessarily invoke a different range of assumptions to those linked with reprocessing facility or facilities undergoing decommissioning after many years of operations involving unsealed radioactive materials. One major difference is the perception of a significantly lower contamination risk in most operational reactor scenarios, although shutdowns, particularly those associated with refuelling of water reactors, can pose significant contamination control challenges.

| Feature for consideration | Good Practice considerations |
|---|---|
| Location and general layout | • The principal controlled area access point and the washing / monitoring area may be separated by a considerable distance, although some monitoring capability must be available at the principal access point (barrier). |
| Contamination control arrangements | • Initial contamination control should be undertaken as close to the reactor as radiological conditions, particularly external radiation levels, will allow.<br>• Justification for variation of footwear requirements between areas might be possible, dependent on contamination monitoring controls, a suitable and sufficient risk assessment, and RPA consultation. |
| Decontamination facilities | • Detailed arrangements for the transfer of a contaminated person to an alternative facility will be necessary, including appropriate contamination control measures. In such a case, care should be taken to minimise any associated skin dose that such a person may receive, either through washing or application of wipes. |

### 9.4 Mobile and/or Temporary Changeroom

The non-permanent nature of mobile or temporary changerooms, combined with what is usually a relatively low rate of usage, means the case for implementing state-of-the-art technology, in support of good practice is not as strong as it might be for other situations. This stance needs to be optimised with the ALARP considerations, ensuring that adequate arrangements are instigated for the hazards and the risk associated with its operations.

| Feature for consideration | Good Practice considerations |
|---|---|
| Location and general layout | • Site (or relocate) the changeroom in a position that optimises the proximity to the work area and the associated radiological conditions.<br>• The mobile changeroom will often comprise only a small shoe-change barrier and an adjacent washing / monitoring area, with users then walking back to a shower / clothing change area that, in extreme cases, may be little more than a hut. |
| Security and access control | • Full automation of security and access control may be impracticable for small / mobile changerooms, but where work is undertaken by a small team this may be addressed by a greater degree of local supervision of the access / egress process. |
| Liquid effluent arrangements | • If there isn't access to an appropriate drainage, then a bowser for waste collection and transfer will be appropriate. |

# 10 GLOSSARY

| | |
|---|---|
| Contact Clothing | Clothing only worn in the controlled area for contamination, such as coveralls, lab coats, shoes. |
| Controlled area | An area designated by the employer in accordance with regulations 16(1) of IRR99[5]. |
| Contingency plan | Pre-planned arrangements for dealing with radiation emergencies. |
| Exit Monitor/contamination detector | Installed monitoring equipment set up to ensure operation in a pre-determined monitor/user configuration, that may also be linked with access control facilities to prohibit the exit of contaminated personnel. |
| Divest | To 'take off' an item of clothing |
| Don | To 'put on' an item of clothing. |
| Exit Monitor/contamination detector | Installed monitoring equipment set up to ensure operation in a pre-determined monitor/user configuration, that may also be linked with access control facilities to prohibit the exit of contaminated personnel. |
| Radiation accident | An event as defined by regulation 2(1) of IRR99[5]. |
| Supervised area | An area designated by the employer in accordance with regulations 16(3) of IRR99[5]. |
| Works Clothing | Clothing, that is not 'Contact Clothing' worn for personal hygiene reasons. |

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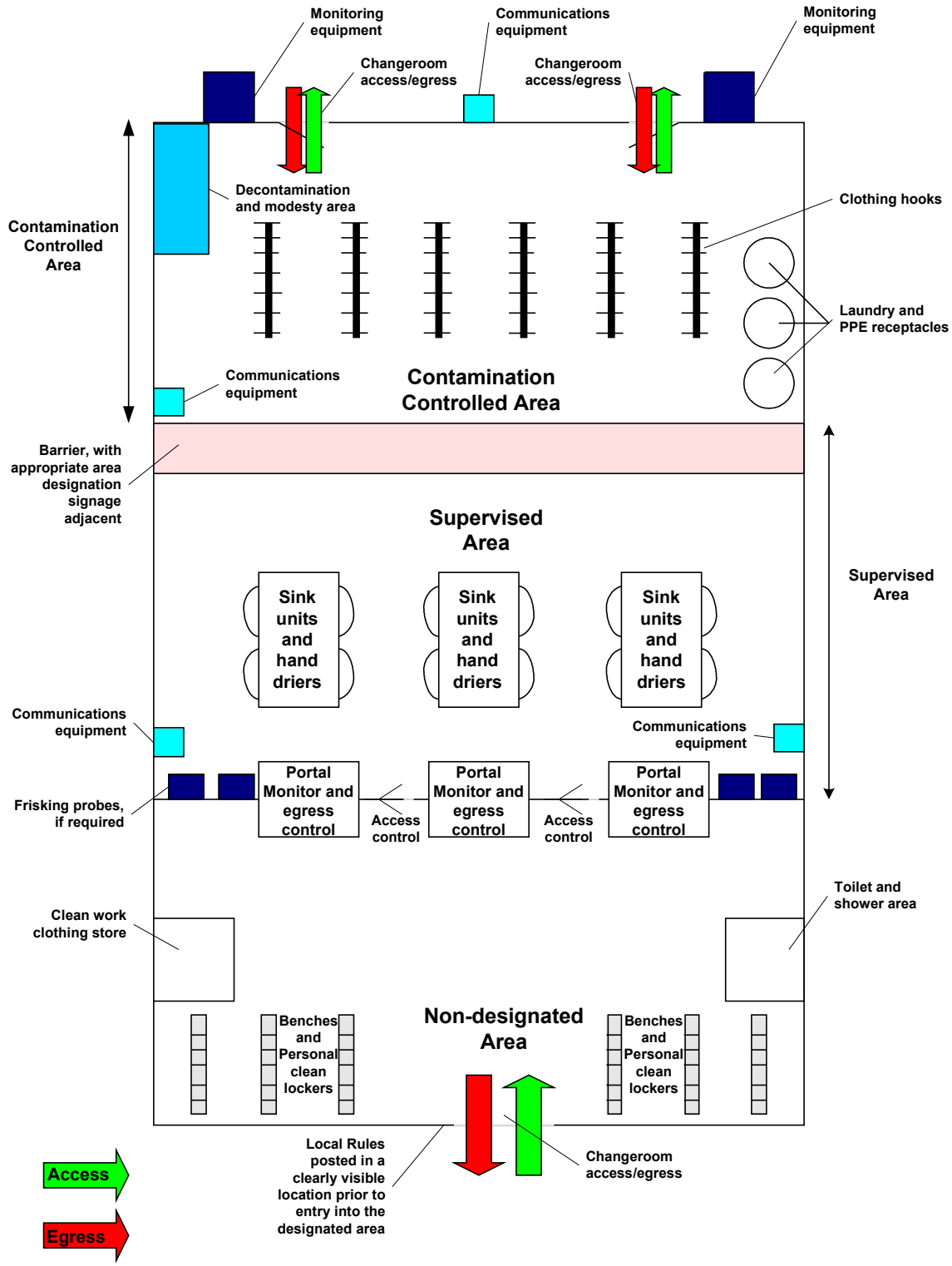
# ANNEX A - ILLUSTRATIVE GOOD PRACTICE CHANGEROOM



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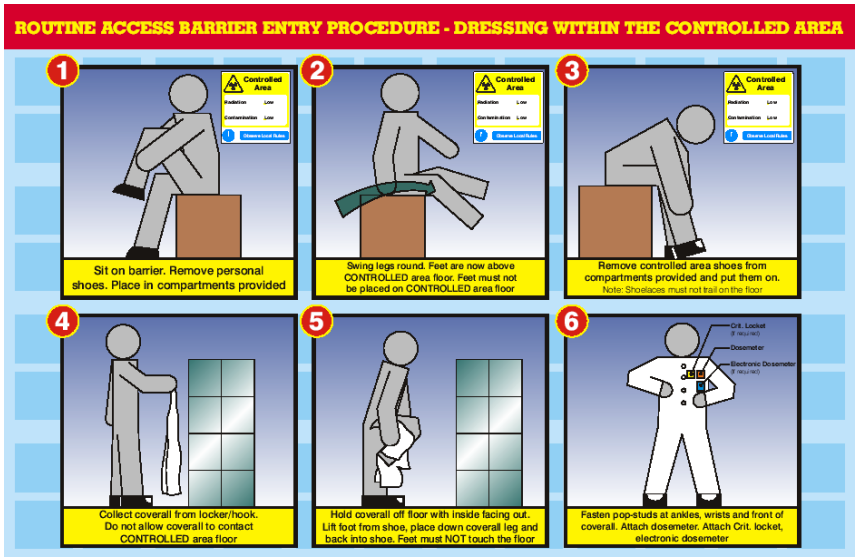
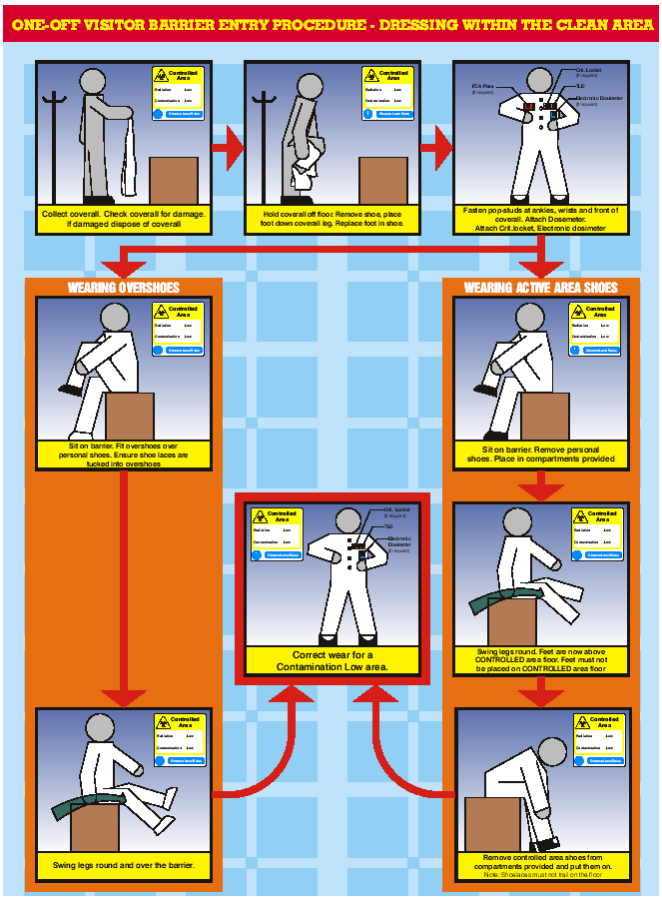
# ANNEX B - EXAMPLES OF BARRIER PROCEDURE SIGNAGE



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# ANNEX C - CHANGEROOM WORKING GROUP - MEMBERSHIP

| | |
|---|---|
| Peter Thompson | UKAEA (Joint Chairman) |
| Trevor Taylor | British Nuclear Group Sellafield Limited (Joint Chairman) |
| Joseph Mansfield | British Nuclear Group Sellafield Limited (Secretary) |
| | |
| Vivienne Armstrong | GE Healthcare |
| Alistair Berrill | HM Naval Base Clyde (Part Time) |
| Craig Buckingham | British Nuclear Group Sellafield Limited |
| Alan Harper | Devonport Management Limited |
| Stuart Johnson | AWE plc. |
| Matthew Lunn | British Energy |
| Andy Mason | Rolls Royce |
| Susan McCready-Shea | HSE/NII (Part Time) |
| David Simister | HSE/NII (Part Time) |
| Christopher Stanford | AWE plc. (Part Time) |

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# ANNEX D - MEMBERSHIP OF THE IRPCG

| | | |
|---|---|---|
| David Owen | AWE plc | Chairman |
| Phil Morgan-Brown | British Energy plc | Secretary |
| | | |
| Chris James | Magnox Electric plc | |
| Mike Gaunt | Rolls-Royce plc | |
| Rick Hallard | British Nuclear Group Sellafield Limited | |
| David Nice | MoD | |
| Shaun Holder | DML | |
| Jim McHardy | GE Healthcare | |
| Simon Morgan | NIREX | |
| Simon Morris | British Energy plc | |
| Kathleen Stevenson | UKAEA | |
| Richard Wilkins | AWE plc | |