

Final Report

Project UKRSR05

**A Review of the Application of 'Best Practicable Means' within
a Regulatory Framework for Managing Radioactive Wastes**

March 2005



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EXECUTIVE SUMMARY

UKRSR05: BPM for the Management of Radioactive Waste (March 2005)

This report represents the outcome of a project whose final aims were (i) to clarify how the UK environment agencies (the 'Agencies') interpret best practicable means (BPM) as applied to the control of radioactive substances, and (ii) to develop advice which Agency staff could use when assessing an operator's application of BPM when carrying out their functions under the Radioactive Substances Act (RSA'93). The project elicited comment by means of an extensive consultation exercise that involved Agency staff and operators of nuclear licensed and the so-called non-nuclear sites, UK Government departments and agencies, all of whom were asked to contribute their views on the application of BPM and its position within a regulatory framework aimed at protecting the public and the environment.

The output of this work is this stand alone report that sets out the regulatory framework, as of August 2004, under which Agency staff assess BPM in relation to airborne, liquid and solid radioactive wastes. The advice about BPM assessment given in this report is applicable to nuclear licensed sites (both operational and those being decommissioned) and non-nuclear sites for which authorisations under RSA'93 are granted (e.g. hospitals, universities, industrial premises). It would apply both to existing and proposed new plant, equipment and operations on these sites.

This report describes BPM and its application to optimise control over radioactive substances. At the current time, the requirement to use BPM is transposed as conditions and limitations included in registrations and authorisations granted by the Agencies under RSA'93, in line with radioactive waste management policy set out in Cm 2919. Through these conditions and limitations, the Agencies require operators to apply BPM so as to minimise the volumes and activities of radioactive wastes that are generated and have to be discharged to the environment, and to reduce the impacts of waste management on people and the environment. The use of BPM is of increasing importance as it is a key mechanism to achieve the Government policy aim of progressive reductions in radioactive discharges into the marine environment.

Fundamental to the control over radioactive substances is a statutory requirement placed on the Agencies to ensure that exposures of members of the public and the population as a whole resulting from the disposal of radioactive waste are kept 'as low as reasonably achievable' (ALARA). There is, however, some confusion as to how the Agencies should apply Government policy. The draft DETR guidance issued to the Environment Agency states that "*BPM should be used to ensure discharges are ALARA*". This statement is not wholly consistent with the Government's view set out in the most recent policy paper (Cm 5552), which states that "*if the operator is using BPM, radiation risks to the public and the environment will be ALARA*". This later policy statement infers that BPM applies to discharges whereas ALARA applies to dose. ALARA stems from the three ICRP'60 basic principles of (i) justification of a practice, (ii) optimisation of protection, and (iii) individual dose and risk limits. **Thus, similar to ALARA, BPM is considered by the Agencies as an optimisation principle. Whereas ALARA applies to dose optimisation, BPM applies to optimise radioactive waste management.**

The Agencies view BPM as a means of engendering a culture of environmental protection with respect to the management of radioactive substances. In all cases, Agencies will seek to ensure that BPM is applied throughout the waste hierarchy, so that it is applied to such aspects as minimising waste creation and ensuring that options for recycling and re-use have been given preference over options for disposal. **The concept of BPM should not, therefore, be viewed solely in terms of 'end of pipe' discharges.**

Using BPM to optimise radioactive waste management is inherently difficult and is a balancing process that has to take cognisance of a variety of inputs including ethical, social, economic and scientific considerations. Thus, the process involved can sometimes mean making difficult decisions, both by site operators and the Agencies. Any such decisions have to meet the requirements of the law, whilst allowing the use of judgment by the Agencies and flexibility for site operators. At the same time, decisions must reflect the values of society at large on the acceptability of different types and levels of risk.

As a matter of principle, the Agencies define no lower threshold of dose or environmental contamination below which BPM does not apply. Operators are thus required to minimise discharges to the point to which it would not be sensible to reduce them any further, whilst taking into account factors such as cost-effectiveness, technological status, operational safety and social and environmental factors. This concept, referred to as proportionality, is thus fundamental to the assessment of what constitutes BPM. The Agencies apply this concept by ensuring that operators do not expend effort, whether in time, trouble or money, that would be grossly disproportionate to the resulting benefits (e.g. reduction in discharges, environmental protection, reduction in radiological dose etc). **Put simply, BPM requires site operators to ensure that the measures in place to manage radioactive wastes are not unreasonably costly.**

In all cases, however, the onus is on the site operator to implement measures to the point where the costs of any further measures would be grossly disproportionate to the risks they would reduce or avert. The essence of a demonstration that BPM applies is to show that the costs of further control over radioactive substances would be grossly disproportionate to the benefits that would result from implementing further options or change to the status quo.

There are, however, no quantitative limits on what is or is not grossly disproportionate and, as a result, a certain amount of judgement and discretion must be exercised by both operators and Agency staff when determining what are BPM for a site or process. The possibility of defining numerical criteria for the evaluation of what is or is not proportional was discussed during the consultation but it was generally acknowledged that it would be difficult, if not impossible, to reach agreement on a single set of numerical criteria that would be appropriate for all sites. In the absence of numerical criteria, guidelines are set out in this report for use by those faced with proportionality considerations and when deciding upon what constitutes BPM when different options provide for differing levels of environmental impacts at differing costs.

For existing plant and processes, the Agencies will require the operator to make progressive improvements in waste management methods, reductions in discharges and in the production and disposal of other radioactive waste. The standard conditions and limitations in authorisations require the application of BPM on a continuing day-to-day basis and require the site operator to

demonstrate compliance with the conditions and limitations. A BPM study for an existing practice should, thus, involve the site operator evaluating the control measures currently in place for managing radioactive substances and assessing whether the existing control measures are sufficient or what more should be done. This ought to consider a number of approaches and options to identify which is the optimum control solution and making this assessment transparent.

In the case of proposed new plant or process, operators should be encouraged to discuss their plans with the Agencies at an early stage. Doing so should help streamline the BPM process, and minimise the financial and project risk to the operator of failing to gain regulatory support for their plans. As part of these discussions, the Agencies may require the operator to submit a BPM study to them for assessment in advance of the plant or process being commissioned. For significant new developments, Agency staff may require that a BPM study is undertaken at the conceptual design stage and they may also wish to be consulted on the scope and factors to be considered in that study. In most cases on a nuclear licensed site, the BPM study will follow a Best Practicable Environmental Option (BPEO) study that defines the strategic waste management approach the operator wishes to adopt. This will not be the case at non-nuclear sites where there is no BPEO requirement.

For the Agencies, assessing an operator's BPM study is essentially a consideration of whether an adequate argument has been made that further measures to reduce risk (or implement more control measures) is not needed because these measures cannot be implemented at a reasonable cost given the economic and social factors to be taken into consideration. Should the Agencies conclude that an operator has not been or is not using BPM, then the matter may be referred by the Agencies to the appropriate authority with a view to bringing a prosecution against the operator for failing to observe a condition or limitation of the authorisation. Should such a matter reach the courts it would be for the court to decide what constituted BPM for any given process at a particular time and whether it was in fact being observed. There is very limited case law on which to base a judgement on what is or is not proportional but the Agencies have developed views as to what is legally required from site operators.

The report looks across at other related environmental protection concepts, particularly BPEO and Best Available Techniques (BAT). There is sometimes confusion between BPM and BPEO but they are intended to be applied in fundamentally different ways. Whereas BPEO looks at assessing the best strategic option to apply to managing radioactive wastes, BPM relates to how to optimise the selected option from the perspective of radiological protection. Put colloquially, BPEO is about doing the right thing and BPM is about doing it the right way. In contrast, BAT is applied by the Agencies for the management of non-radioactive pollutants under Integrated Pollution Control (IPC) legislation. **The Agencies view is, however, that BPM and BAT are synonymous, both having the aim of balancing costs against environmental benefits by means of a logical and transparent approach to identifying and selecting processes, operations and management systems to reduce discharges.**

Based on the outcome of the consultation processes and other work undertaken as part of this project, this report provides advice to Agency staff that may be useful when assessing an operator's implementation of BPM. This advice will be trialled in a 'learning network' over a period of around 12 months during which time Agency staff will be asked to use this advice as part of their regular

inspection activities and operators making a BPM study will be invited to refer to the report and feedback their comments. All observations, experiences and comments from Agency staff and operators on the advice will be collated and subsequently used to develop a formal assessment framework and, possibly, a guidance manual at a later date.

A number of issues arose during this project that could not be resolved in this report, particular with regards to the harmonisation of environmental regulation, health and safety of workers, and the development and application of generic BPM studies. As part of the learning network, Agency staff and operators are encouraged to comment on these and any other issues that may require further analysis before a formal guidance manual could be issued.

Key words: best practicable means, radioactive waste, radioactive discharges, environmental legislation, environmental protection.

GLOSSARY

ALARA	As Low As Reasonably Achievable. In terms of doses to the public as defined by the International Commission on Radiological Protection.
ALARP	As Low As Reasonably Practicable. In terms of doses to workers as defined by the International Commission on Radiological Protection.
AURPO	Association of University Radiation Protection Officers.
Authorisation	Granted by one of the environment agencies under the Radioactive Substances Act 1993 for the controlled and restricted discharge of radioactive pollutants to the environment.
BAT	Best Available Techniques. Means to reduce discharges of non-radioactive pollutants under Integrated Pollution Control Regulations.
BATNEEC	Best Available Technology Not Entailing Excessive Costs.
BPEO	Best Practicable Environmental Option “... <i>the outcome of a systematic and consultative decision-making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term.</i> ” [Royal Commission on Environmental Pollution, Twelfth Report, 1988].
BPEO Assessment	An assessment carried out by a body such as one of the environment agencies of a BPEO study carried out by an operator.
BPEO study	A study carried out by or on behalf of a nuclear site operator of the BPEO with respect to some aspect of radioactive waste management. The term BPEO study refers to the whole process, including any external consultation stages.
BPM	Best Practicable Means “... <i>that level of management and engineering control that minimises, as far as practicable, the release of radioactivity to the environment whilst taking account of a wider range of factors, including cost-effectiveness, technological status, operational safety, and social and environmental factors.</i> ” [Cm 2919].
BPM Assessment	An assessment carried out by a body such as one of the environment agencies of a BPM study carried out by an operator.
BPM study	A study carried out by or on behalf of a site operator, of the BPM with respect to some aspect of control on radioactive waste management. The term BPM study refers to the whole process.
BSS	Euratom Basic Safety Standards Directive (BSS Directive), issued by the European Commission.
Condition	A specific restriction or requirement placed on an operator and contained in an Authorisation granted by one of the environment agencies.
CEC	Commission of the European Communities.
Decommissioning	The set of actions taken at the end of a nuclear facility's operational life to take it permanently out of service. It includes actions systematically and progressively to reduce the level of hazard on a site and may include the dismantling of the facilities. Decommissioning is not necessarily a single step process and may involve stages spread over a number of years. Its ultimate aim is to make the site suitable for other purposes.
Defra	Department for Environment, Food and Rural Affairs.

DETR	Department of the Environment, Transport and the Regions (for the purposes of this report, Defra's predecessor).
DoE	Department of the Environment (for the purposes of this report, DETR's predecessor).
DTI	Department of Trade and Industry.
EA	Environment Agency.
EHS	Environment and Heritage Service, of Northern Ireland.
EMS	Environmental Management System.
EPA	Environmental Protection Act 1995.
EQS	Environmental Quality Standard. Standards set or agreed by the Agencies for non-radioactive pollutants in the environment.
FSA	Food Standards Agency.
H1	IPPC Horizontal Guidance Note H1.
HLW	High Level Radioactive Waste. Waste whose high radioactivity content renders it heat generating.
HSE	Health and Safety Executive.
IAEA	International Atomic Energy Agency.
ICRP	International Commission on Radiological Protection.
ILW	Intermediate Level Radioactive Waste. Waste with a radioactivity content exceeding 4 GBq/tonne alpha or 12 GBq/tonne of beta/gamma activity but which is not heat generating.
IPC	Integrated Pollution Control.
IPPC	Integrated Pollution Prevention and Control.
IWS	Integrated Waste Strategy. An integrated waste strategy is an outline plan, taking into account environmental principles, that can be applied consistently to all actual and potential sources of waste, both radioactive and non-radioactive, within the scope of the strategy. The scope may extend to the whole of a complex nuclear site or even to multiple sites. A BPEO study may be needed to identify a suitable strategy.
LLW	Low Level Radioactive Waste. Waste with a radioactivity content below the lower limit for Intermediate Level Radioactive Waste.
LMU	Liabilities Management Unit.
NDA	Nuclear Decommissioning Authority.
NII	Nuclear Installations Inspectorate, part of the HSE.
Non-nuclear site	A site (e.g. hospital or university) authorised by one of the environment agencies to keep, use or handle radioactive materials, that is not licensed by the Nuclear Installations Inspectorate. Synonymous with the term "small user".
NRPB	National Radiological Protection Board.
Nuclear licensed site	A site licensed by the Nuclear Installations Inspectorate for the purposes of installing or operating a nuclear installation.
Option	In this document, a potential means of optimising a strategic waste management approach to achieve a specified objective such as reducing discharges or solid waste arisings.
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic.

Practice	An activity which results in an increase to the overall exposure to radiation of individuals.
Proportionality	The concept by which discharges are minimised to the point to which it would not be sensible to reduce them any further, whilst taking into account factors such as cost-effectiveness, technological status, operational safety and social and environmental factors.
PPC	Pollution Prevention and Control.
QA	Quality Assurance.
QNL	Quarterly Notification Levels. Reports from operators to the environment agencies specifying the levels of recent discharges.
Registration	Licence granted by on the environment agencies for the controlled holding of radioactive substances.
RCEP	Royal Commission on Environmental Pollution.
RIFE	Radioactivity in Food and the Environment. Reports issued by the Food Standards Agency.
RSA'93	Radioactive Substances Act 1993.
RWMAC	Radioactive Waste Management Advisory Committee. Advisory committee to the UK Government, currently in abeyance.
SEPA	Scottish Environment Protection Agency.
SFAIRP	So Far As Is Reasonably Practicable.
Small user	See "non-nuclear site".
SNIFFER	Scottish and Northern Ireland Forum For Environmental Research.
SULG	Small Users Liaison Group. Groups facilitated by the environment agencies to bring together operators of non-nuclear sites.
Uncertainty	In this document, lack of definite information on a matter relevant to a BPM study.
VLLW	Very Low Level Radioactive Waste. This waste is a subset of LLW and is uniquely defined in terms of activity and volume. It is intended to cover small volumes of low-activity wastes that may be disposed of with ordinary refuse. It is defined as each 0.1 m ³ containing less than 400 kBq of beta/gamma activity or single items containing less than 40 kBq of beta/gamma activity.

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1 INTRODUCTION

1.1 Background to the project

The Environment Agency of England and Wales (EA), the Scottish Environment Protection Agency (SEPA) and the Environment and Heritage Service of Northern Ireland (EHS)¹ have identified needs to:

- clarify how the Agencies interpret 'best practicable means' (BPM) as applied to the control of radioactive substances, and
- develop advice which Agency staff can use for assessing the application of BPM when carrying out their functions under the Radioactive Substances Act 1993 (RSA'93).

The principle of BPM is far from new and has been part of pollution control regulation in the UK since the 1870s and part of radioactive waste regulation since about 1960. At the current time, the requirement to use BPM is transposed as conditions and limitations included in registrations and authorisations granted by the Agencies under RSA'93 in line with radioactive waste management policy set out in Cm 2919.

The primary purpose of BPM is to minimise disposals and discharges of radioactivity to the environment so as to achieve a high standard of protection for the public and the environment. The use of BPM is of increasing importance as it is a key mechanism to achieve the Government policy aim of progressive reductions in radioactive discharges into the marine environment.

A project to support the development of this advice was carried out over the period from the autumn of 2002 to the autumn of 2004. It was supervised by a Project Board made up of representatives from the three Agencies and a representative from the Scottish and Northern Ireland Forum For Environmental Research (SNIFFER) who provided funding for the project.

SNIFFER identifies and manages environmental research on behalf of its members (SEPA, EHS, Scottish Executive, Scottish Natural Heritage and the Forestry Commission) and other stakeholders. Agreements between SEPA, EA and EHS formalise the co-ordination and management of UK research funds on a number of topics within Scotland and Northern Ireland, including the UK radioactive substances regulation programme.

1.1.1 Project objectives

The original aims of the project included a number of specific objectives which are defined in Appendix I along with the specification and terms of reference for the project.

The original aims and objectives were met in part. The SNIFFER Project Board decided, however, not to progress to the implementation of a formal guidance manual. This decision was informed by the fact that there was no clear consensus between the consultees with regard to how BPM should be applied within the

¹ Collectively referred to in this report as the 'Agencies'.

RSA'93 regulatory framework (e.g. in relation to how the guidance should balance the need for it to be both flexible and prescriptive).

Thus, the revised aims of the project were to:

- clarify how the UK environment agencies (the 'Agencies') interpret best practicable means (BPM) as applied to the control of radioactive substances; and
- develop advice about the regulatory framework which BPM sits in that may be used by Agency staff to support their assessment of an operator's study and implementation of BPM when carrying out functions under RSA'93.

In addition, a number of outstanding issues are discussed that may require to be examined in further detail at some time in the future.

1.1.2 Project scope

The scope of this report is restricted to those sites for which authorisations and registrations under RSA'93 are granted by the Agencies that set conditions and limitations on operators with respect to BPM in relation to the management of radioactive wastes. This includes:

- nuclear licensed sites (both operational and those being decommissioned), and
- other types of sites, the so-called 'non-nuclear' sites² (e.g. hospitals, universities, industrial premises) where radioactive wastes are generated or disposed.

The scope includes both existing and proposed new plant, equipment and operations on these sites, and parts of it may also be useful in assessing compliance with BPM in other RSA'93 contexts (e.g. sampling and monitoring).

1.1.3 Audience for this report

This report is intended primarily to provide staff in the three UK environment agencies with further information on the background and regulatory context of BPM which may be useful when they are assessing an operator's application of BPM. It is recognised, however, that this report will also provide some useful reference material for those undertaking BPM studies, and other interested stakeholders.

This report is also intended to inform all relevant parties of the programme for the development of the formal assessment framework and guidance manual.

1.2 Consultation

This project was informed by a consultation process that involved eliciting information and views from Agency staff and operators of nuclear licensed and non-nuclear sites, UK Government departments and agencies, and other relevant parties. These stakeholder groups were asked to provide comment on the fundamental principle of BPM and its position within a regulatory framework

² The term "small user" may be used interchangeably with the term "non-nuclear site".

aimed at protecting the public and the environment. In addition, other views were sought including first-hand experiences of operators who have performed BPM studies and Agency staff who have assessed them.

Many varied and interesting views were expressed during the consultation and these have been fed into this project and are used to frame the advice to Agency staff provided in Section 4. The findings of, and conclusions from, the consultation process are described in detail in Appendix II of this report.

The consultation process started with the distribution of questionnaires to interested parties. These questionnaires invited respondents to comment on their understanding and opinions of the current regulations related to BPM, their recent experiences of undertaking or determining BPM studies and their suggestions for possible future developments. The questions from these two questionnaires are provided in Appendix III.

Two initial workshops (one for operators and a second for Agency staff) were then held to debate specific issues that the questionnaire responses highlighted as being of most interest or concern, or where disagreement was greatest. At these workshops participants worked in syndicate groups to discuss the following specific issues:

1. The definition and objective of BPM, and its relationship to other regulatory requirements and principles.
2. The scope of BPM, and appropriate procedures and methodologies for undertaking one.
3. Operator-regulator interactions throughout the BPM process.
4. Proportionality issues and how these may be addressed in the BPM process.

The syndicate group participants were encouraged to address and discuss key issues related to these themes on the basis of their own personal and corporate experiences.

Two further workshops were subsequently held specifically for representatives of non-nuclear sites to ensure their views were properly fed into the consultation programme.

1.3 Further work

Following its publication, it is the Agencies' intention that this report will be put on each of their websites. It is intended that the advice would be trialled by Agency staff over a period of about 12 months within the context of a 'learning network' during which:

1. Agency staff will be asked to use the advice as part of their regular review, inspection and monitoring activities; and
2. operators undertaking BPM studies will be invited to refer to the report and feedback their comments.

As part of the learning network, all observations, experiences and comments from Agency staff and operators on the suitability and applicability of the advice would be collated and subsequently used to update and improve the regulatory assessment framework and feed into the guidance manual to be produced at a later date.

2 BACKGROUND TO BPM AND THE AGENCIES' INVOLVEMENT

The history of BPM in environmental regulation is summarised in Appendix IV which also describes how BPM was introduced to radioactive waste regulation in the 1960s. The requirement to use BPM is included as conditions and limitations of authorisations and registrations granted to operators by the Agencies under RSA'93 in line with radioactive waste management policy set out in Cm 2919. These specific conditions and limitations are provided in Appendix V. The primary purpose of BPM is to minimise discharges of radioactive substances to the environment so as to achieve a high standard of protection for the public and the environment, and this use of BPM has been reaffirmed in the UK strategy for radioactive discharges [Defra, 2002a]. The definition of BPM and its role in discharge reduction as set out in Cm 2919 is:

'Within a particular waste management option, the BPM is that level of management and engineering control that minimises, as far as practicable, the release of radioactivity to the environment whilst taking account of a wider range of factors, including cost-effectiveness, technological status, operational safety, and social and environmental factors.'

BPM is applicable to all discharges authorised under RSA'93 and, thus, the Agencies seek to ensure that BPM is applied both at nuclear licensed sites and non-nuclear sites (such as universities and hospitals). The Agencies view BPM as a means of engendering a culture of environmental protection with respect to the management of radioactive substances. In all cases, Agencies will seek to ensure that BPM is applied throughout the waste hierarchy, so that it is applied to such aspects as minimising waste creation and ensuring that options for recycling and re-use have been given preference over options for disposal. The concept of BPM should not, therefore, be viewed solely in terms of 'end of pipe' discharges.

An operator's BPM study should provide a logical and transparent record of the decision making process. In particular, it should demonstrate how different potential options for processes, operations and management systems to reduce discharges were identified and compared, and how their implementation optimises radioactive waste management. The assessment should include a document setting out the basis for the final decision.

The approach to environmental protection under RSA'93 by the application of BPM is thus similar in many ways to the decision making processes of other environmental protection regulations for non-radioactive pollutants and other regulatory systems such as Integrated Pollution Control (IPC) and the application of best available techniques (BAT). In terms of the legislative regimes for the protection of land, water and air from non-radioactive pollutants, the general practice is that environmental quality standards (EQSs) are set or agreed by the Agencies, and limitations and conditions in licenses are defined to ensure that such EQSs would not be exceeded. This use of EQS's means that there is a more prescriptive link between limitations and conditions, and environmental impact, and hence compliance with environmental policy is relatively transparent.

In the RSA'93 regime, however, the requirement to optimise environmental protection is approached in a different way. RSA'93 is a non-prescriptive regulatory regime that aims to control the keeping and use of radioactive material with a view to minimising the production, accumulation and subsequent disposal

of radioactive waste. Thus BPM is applied to ensure public radiation exposures from radioactive disposals are 'As Low As Reasonably Achievable' (ALARA), and that the sum of all exposures (excluding medical exposures) to any individual member of the public does not exceed the 1 mSv per year dose limit set by the Directions issued to the Agencies under the Basis Safety Standards (BSS) Directive.

2.1 BPM studies by operators and their assessment by the Agencies

2.1.1 Nuclear licensed sites

The standard conditions and limitations included in an authorisation issued under RSA'93 require an operator of a nuclear licensed site to apply BPM continuously to all of their activities that involve the handling of radioactive substances, across all of their plants and process. As part of their normal inspection programme, Agency staff will seek to satisfy themselves that an operator is applying BPM comprehensively in compliance with these conditions and limitations. The process used for checking regulatory compliance will be slightly different depending on whether the BPM study is for an existing or a proposed new operation. The key elements in the comprehensive BPM decision making cycle are shown graphically in Figure 1.

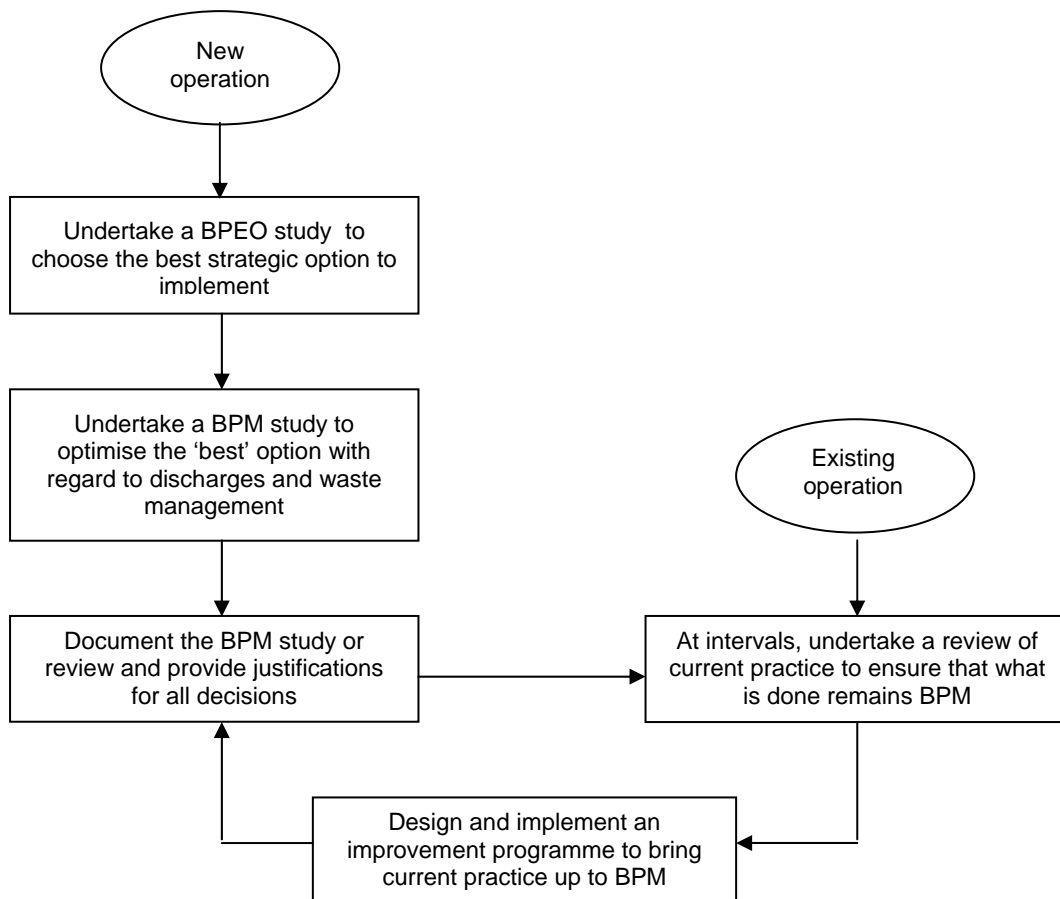


Figure 1: Simplified flow chart showing the key elements in the BPM decision making cycle that an operator of a nuclear licensed site should undertake and which Agency staff may wish to assess.

This decision making cycle shown in Figure 1 is illustrative and not fixed, elements of it may change from case to case, or some elements may be combined or truncated, but the main aspects of the cycle would be common to all BPM decisions on nuclear licensed sites.

Normally, what represents BPM will change with time both as a result of technological developments and in the light of policy, regulatory and societal changes. As such, in the case of existing and significant plant and processes, the Agencies would normally expect the operator to undertake a rolling programme of BPM studies to ensure that BPM continue to be applied. The output from this programme may require an appropriate improvement or optimisation programme to be implemented to ensure that discharges are progressively reduced. It is a condition of any authorisation that an operator is required to maintain written documentation to show that they have made appropriate studies of what represents BPM and, if necessary, what improvements were implemented as a result. Unless specifically required to do so in the improvement programme, the operator is not normally required to submit this documentation to the Agencies but may be requested to make it available during an inspection by Agency staff or any other time.

In the case of a proposed new plant or process (or substantial modification of existing facilities that represents a new process involving the creation or disposal of radioactive waste), the operator should discuss with the Agencies at an early stage in the design process, and subsequently as necessary, their BPM study. Before commissioning new plant, a fully developed BPM case should be submitted to the Agencies. In most cases, this BPM study will follow on from a best practicable environmental option (BPEO) study or other review of waste management options that will have defined the strategic waste management approach to be adopted.

The level of detail in a BPM study will generally be proportionate to the complexity of the installation and the nature of its likely effects upon the environment locally and further afield. The BPM study may be part of the process the operator uses:

- to show that the operation and management of the plant is optimised within the authorised disposal and discharge limits; and
- the plant, its operation and management is optimised, but disposal or discharge limits need to be increased.

Undertaking and recording a BPM study should not necessarily involve extensive documentation for simple processes.

In the case of both existing and proposed new plant and process, the Agencies will seek to satisfy themselves that an operator is using BPM in compliance with the conditions and limitations of their authorisation or can demonstrate that BPM will apply to a new or substantially revised process. In so doing, the Agencies will be interested not only in *what* an operator assesses to be BPM but also in *how* the operator makes that study and justifies their chosen option. Of particular concern to Agency staff during their assessment of the operator's BPM study will be the level of waste arisings or discharge that will occur and to what extent the operator has applied cost-benefit proportionality considerations when choosing what to do to manage their wastes.

Within an existing site, the implementation of BPM is not an easy task because of the existing infrastructure and local circumstances. This report does not, however, distinguish between BPM for new and existing installations.

2.1.2 Non-nuclear sites

The application of BPM by an operator of a non-nuclear site is different to that on a nuclear licensed site because of the differences in the conditions and limitations imposed by the Agencies (see Section 3.3). As described in Section 3.3, the Nuclear Installations Inspectorate, HSE(NII), has the regulatory responsibility for controlling radioactive substances on nuclear licensed sites. Off-site discharge or disposal of radioactive wastes is regulated by the Agencies. In contrast, the Agencies have the statutory responsibility for regulating the control of radioactive substances on a non-nuclear site. The Agencies implement such controls through the granting of registrations under RSA'93 allowing the keeping and use of radioactive material as well as authorisations under RSA'93 allowing the discharge or disposal of radioactive waste. Each of the Agencies include standard conditions in its Certificate of Authorisation requiring non-nuclear sites to use BPM to minimise both the volume and activity of all radioactive wastes. Thus, the Agencies view is that the requirement to use BPM extends not only to waste discharge or disposal (i.e. is not applied as a control mechanism to end of pipe discharges) but to the practices in place to keep and use radioactive material, so that BPM is applied to the management of all radioactive substances on the site.

The Agencies do not require an operator of a non-nuclear site to undertake a BPEO study but will expect them to demonstrate that BPM are being applied for existing operations or will be applied for new operations. The relevant decision making cycle is shown in Figure 2.

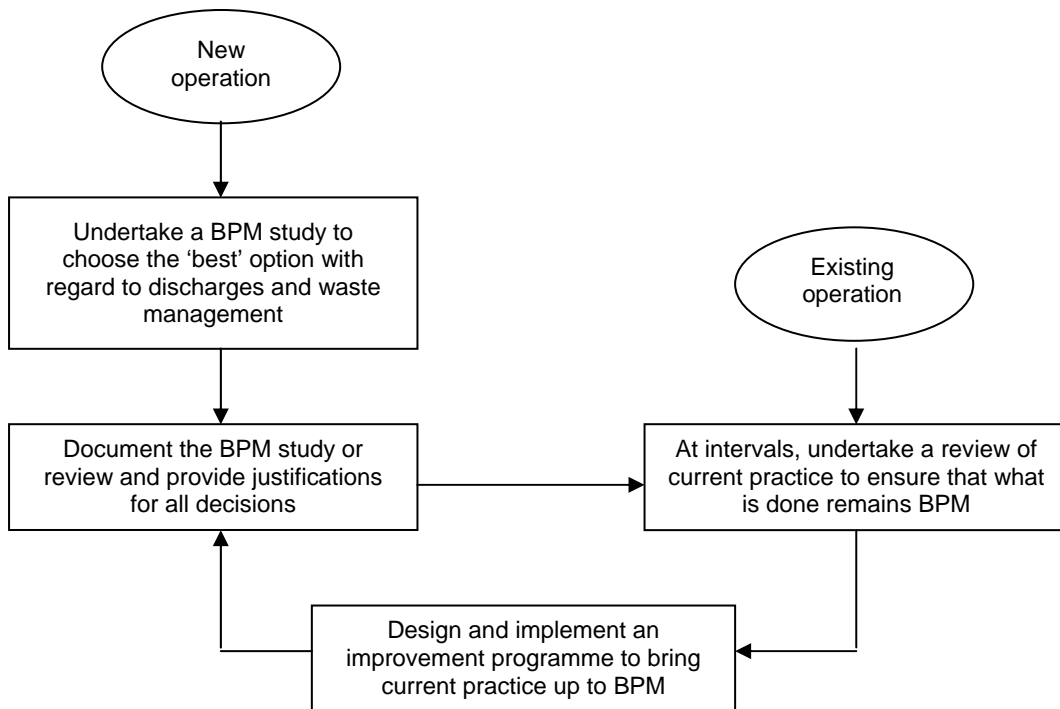


Figure 2: Simplified flow chart showing the key elements in the BPM decision making cycle that an operator of a non-nuclear site should undertake and which Agency staff may wish to assess.

For a new operation, the operator will need to consider a range of options in a BPM study to minimise disposals as well as the volumes and activities of wastes produced. For existing operations, the operator will need to review current processes, operations, procedures and management systems and to assess possible changes to them that will lead to progressive reductions in discharges, and waste volumes and activity created. All such studies and reviews should be appropriately documented.

2.2 Fundamental aspects of a BPM study

2.2.1 Lower cut-off

The Agencies interpretation of UK Government policy is that there is no lower threshold of dose or environmental contamination below which BPM does not apply. All unnecessary introductions of radioactivity into the environment are considered by the Agencies to be undesirable, even at levels where doses are low and on the basis of current knowledge are unlikely to cause harm. The progressive reduction of discharge limits and of actual discharges by the continuing use by operators of BPM is considered by the Agencies to be a central principle controlling radioactive waste management.

Cm 2919 includes that below a dose of 20 $\mu\text{Sv/yr}$, the Agencies need not seek further reductions in exposure of the public provided they are satisfied that BPM are being used to limit discharges. The view of the Agencies is that this statement should not be interpreted as a lower dose cut-off for BPM. During the consultation process, some consultees did propose that such a change in policy should be implemented, or that some parameter other than dose should be used to define a lower cut-off. This view was supported by several non-nuclear site operators whose practices already result in doses less than 20 $\mu\text{Sv/yr}$ but whose radioactive wastes are not covered by an Exemption Order which would exempt their practice from regulation under RSA'93.

Nonetheless, to ensure that the Government's policy of progressive discharge reductions is met, the current policy of the Agencies should be maintained, and no lower cut-off should be defined below which BPM does not apply. This maintains consistency with the way in which the HSE(NII) apply As Low As Reasonably Practicable (ALARP) [HSE, 2001a]. It is appropriate because even the lowest doses, risks or levels of environmental contamination should be reduced if it is cost-effective to do so. For practices that generate only low levels of discharges, the operators should be required to expend proportionate (i.e. less) effort in their BPM studies.

2.2.2 Proportionality requirements for site operators

Operators are required to use BPM so as to minimise discharges to the point to which it would not be sensible to reduce them any further, whilst taking into account factors such as cost-effectiveness, technological status, operational safety, social and environmental factors (the proportionality concept). In comparing such factors for a range of waste management options, a certain amount of judgement has to be applied to evaluate their relative importance and at what levels such things as the cost which would be incurred in implementing them are deemed to be acceptable or unacceptable.

The concept of proportionality is thus central to the application of BPM and the Agencies will seek to have BPM implemented in a manner that is proportionate to the environmental risk presented by the operation of the plant, process or installation. The Agencies policy is not to require operators to incur expenditure, whether in money, time or trouble, that would be disproportionate to the resulting benefits. This policy is included in the standard conditions and limitations in authorisations issued by the Agencies (see Section 3.3). BPM ensures that the cost of applying techniques is not excessive in relation to the environmental protection they provide. It follows that the more environmental damage BPM can prevent, the more the Agencies can justify telling the operator to spend before the costs are considered excessive.

Proportionality considerations extend both to the expenditure to implement new or improved approaches to achieve discharge reductions, as well as to the expenditure in making a BPM study. There are, however, no quantitative limits on what is or is not disproportionate. Assessing what is proportionate is a balancing process and is inherently complex, with a variety of inputs including ethical, social, economic and scientific considerations. Thus, by its nature, it can sometimes mean the Agencies and operators having to make difficult decisions. Such decisions have to meet the requirements of the law, whilst allowing the use of judgment by Agency staff in setting BPM conditions and flexibility for nuclear operators to meet the requirements of their conditions and limitations. At the same time, it must reflect the values of society at large on the acceptability of different types and levels of risk. As such, a certain amount of discretion must be exercised by Agency staff when assessing an operator's BPM study.

It would be desirable if clear criteria could be used by the Agencies in deciding what is 'grossly disproportionate' or 'disproportionate' in terms of how they translate as conditions in RSA'93 authorisations and those criteria should be recorded. At present, however, neither the Agencies nor the HSE(NII) have defined any formulation for evaluating the size of the disproportion factor for a given level of risk. In its guidance to inspectors about expectations of site operators to meet the ALARP legal principle, HSE(NII) has stated, however, that

"A demonstration that risks have been reduced ALARP is for the operator to show that the costs of improving safety further would be grossly disproportionate to the benefits that would accrue from implementing any further options for improvement or change to the status quo".

During the consultation, various possible criteria for evaluating proportionality were discussed that related to level of dose to humans, amount of activity discharged compared to current authorisation limits and £/manSv relationships. All those consulted felt that it would be difficult, if not impossible, to reach agreement on a single set of numerical criteria that would be appropriate for all sites. This does not mean, however, that a detailed analysis of control measures is needed, the emphasis for operators is that any assessment must be fit for purpose.

There is limited case law to help define what is 'grossly disproportionate' or 'disproportionate' in relation to RSA'93. There is, however, relevant case law with respect what is considered 'reasonably practicable' with regard to the Health and Safety at Work Act 1974 (HSWA'74). The purpose of HSWA'74 is to protect the health, safety and welfare of people at work. The Act requires employers to ensure 'so far as is reasonably practicable' (SFAIRP) that employees are not

exposed to risks to their health and safety from the employer's business. The test for what is reasonably practicable was set out in the case of *Edwards v National Coal Board* [1949]. Lord Justice Asquith in his judgement in the case stated:

“ ‘Reasonably practicable’ is a narrower term than ‘physically possible’ and seems to me to imply that a computation must be made by the owner in which the quantum of risk placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other, and that, if it be shown that there is a gross disproportion between them - the risk being insignificant in relation to the sacrifice - the defendants discharge the onus on them. Moreover this computation falls to be made by the owner at a point in time anterior to the accident.”

This case established that risk must be balanced against the expenditure whether in money, time or trouble, needed to avert or mitigate the risk. By carrying out this exercise the employer can determine what measures are reasonable to take.

Although applied to a different regulatory regime, it is the Agencies view that reasonably practicable as applied under HSWA'74 is similar to how best practicable is applied to control radioactive substances. Both SFAIRP and BPM require a balance between risk and expenditure; SFAIRP applies to protect workers whereas BPM applies to protect the environment.

2.2.3 Proportionality requirements for the Agencies

The regulatory effort needed to assess an application and any licence conditions should also be proportionate and take account of the complexity of an installation and its environmental effects. There is no precise algorithm used by the Agencies to assess what constitutes BPM in particular circumstances to manage radioactive wastes. In practical terms a BPM study is about defining the point at which the 'law of diminishing returns' applies. In practice, this means that it is no longer reasonable to expend additional money or effort attempting to reduce discharges further. Generally, the level of discharge reduction that could be achieved by an operator is related to the amount of money and effort they may expend on installing new equipment or implementing new management procedures. This is indicated graphically in Figure 3 for a hypothetical situation in which 5 alternative options (A-E inclusive) are available to an operator to control discharges.

Low cost, simple options plot to the left hand side of the diagram and high cost, advanced options plot to the right. Clearly, for these options, the trend in the relationship between costs (in the form of money, time and trouble) and the release of radioactive wastes follows a downward trend. Provided that no discharge limits are breached, the application of proportionality would mean that Agency staff would not expect the operator to implement an option that would plot at the far right of the diagram incurring high and, possibly, unnecessary costs. Thus, the option that represents BPM would plot near Option C, where the diminishing returns are evident and the level of costs (in money, time and trouble) is proportionate to the level of reduction in discharges that is achieved.

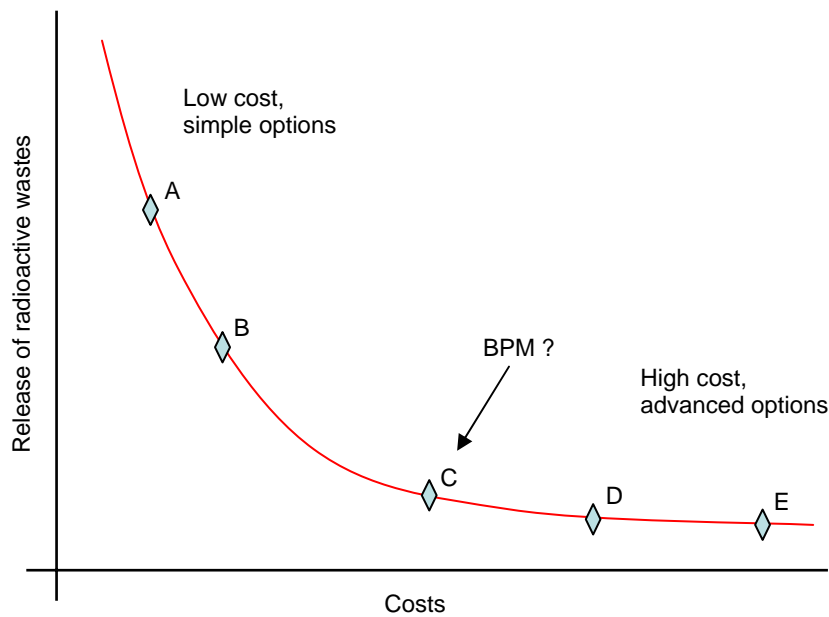


Figure 3: Generalised graphical representation of the performance of a number of waste management options (A-E) where proportionately less reduction in discharges is achieved for increasing costs (where costs include money, time and trouble).

2.2.4 Justification of Practices

In relation to legislation for radioactive waste management, it should be noted that while all practices involving radioactive materials on both nuclear licensed and non-nuclear sites must be justified, justification arguments themselves do not fall within the remit of a BPM study and are a matter for Government. The Justification Regulations (2004) set out the process for justification, and what is required to be justified is a particular class or type of practice and not individual uses.

2.3 The BPM study

2.3.1 Identifying BPM Options

As part of any BPM study or review, an operator should present in a transparent way the various BPM options which could improve the aspect being considered (e.g. reduce the level of discharge). The option or combination of options that achieves the greatest improvement should be implemented, provided it is reasonably practicable. It is not sufficient to consider the cheapest option first and consider the more expensive options only for the marginal improvement they would give. Possibilities may include partial implementation of an option and implementation of more than one option. The presentation and discussion of discarded options is a valuable part of a BPM study, as are the reasons for discarding them.

Assessing BPM involves comparing the techniques that prevent or reduce emissions and identifying the best one in terms of the one which will have the lowest impact on the environment.

2.3.2 Undertaking a BPM Study

Once the options have been identified the operator should evaluate their environmental effects, focussing particularly on the significant environmental effects, both direct and indirect. The operator should also look at the major advantages and disadvantages of techniques used to deal with them. Where appropriate, account can be taken, in particular, of the various factors listed in Schedule 2 to the PPC Regulations. Similarly, the operator may take account of the following considerations addressed in Chapter 6 of the draft statutory guidance on discharges, particularly with regard to achieving a balance between:

- considerations of risk and exposure,
- environmental considerations,
- technological considerations,
- health and safety considerations, and
- cost effectiveness.

These various factors can be used as part of a BPM study to help to rank techniques according to their overall environmental effects. The main focus of the environmental assessment (part of the overall BPM study) will be on the activity discharged. Most attention should be paid to high activity releases and releases of the more radio-toxic pollutants. These are likely to have the most significant environmental effects.

The need to carry out a BPM (or BPEO) study when required is absolute and cannot be argued against on cost grounds. The scope, depth and effort put into the study should, however, be related to the potential benefits. A detailed study will not always be necessary; the study should be fit for purpose. Most BPM studies include some aspects that are difficult to quantify. Where the issues are more substantial, however, correspondingly greater effort needs to be put into logical rigour and quantification.

3 POLICY, LEGISLATION AND GUIDANCE RELATING TO BPM

The history of BPM in environmental legislation, and its context and application to radioactive waste management, is summarised in Appendix IV.

3.1 BPM in the context of present-day environmental policies

The fundamental purpose of applying BPM in the context of radioactive waste management remains one of environmental protection. From the Agencies' perspective, the regulatory requirement to apply BPM is about engendering a culture of environmental protection with respect to the management of radioactive substances in a manner that is complementary to the safety culture which is promoted by the HSE(NII). In this regard, BPM is best viewed as a non-prescriptive regulatory approach to meet a number of specific environmental protection objectives within the overarching framework of the Government's environmental policy that relates to the principles of sustainable development and human rights. Examples of policy aims and objectives relevant to environmental protection are:

- polluter pays;
- use of best scientific knowledge;
- taking costs and benefits into account;
- justification of practices and optimisation of practices with respect to impact;
- sustainable development;
- waste minimisation;
- progressive reduction in discharges to the marine environment;
- protection of human species and non-human species;
- protection of people's use of the environment;
- protection beyond national boundaries; and
- precautionary principle.

3.1.1 BPM assessments

The underlying assessment process for determining whether the BPM principle is being applied involves identifying options, assessing environmental effects and considering both the economic and social perspectives. As such, the process needs to take the following into consideration:

- the use of low-waste technology;
- the efficient use of resources;
- the prevention and reduction of the environmental impact of emissions; and

- the use of less hazardous substances.

The principles of precaution and prevention are also relevant factors for BPM studies.

UK environmental policy is set out in a series of Command documents (White Papers) which set out in detail Government policies relating to specific issues. As discussed in Section 2, the currently applied definition of BPM and its role in meeting environmental protection objectives through discharge reduction is set out in Cm 2919. More recently, this definition and role of BPM in meeting Government environmental policy aims was confirmed in Cm 5552 [DTI, 2002], which describes BPM as follows.

“a term used by the EA and SEPA in authorisations issued under the Radioactive Substances Act. Essentially, it requires operators to take all reasonably practicable measures in the design and operational management of their facilities to minimise discharges and disposals of radioactive waste, so as to achieve a high standard of protection for the public and the environment. BPM is applied to such aspects as minimising waste creation, abating discharges, and monitoring plant, discharges and the environment. It takes account of such factors as the availability and cost of relevant measures, operator safety and the benefits of reduced discharges and disposals. If the operator is using BPM, radiation risks to the public and the environment will be ALARA.”

Due regard is taken of UK policy in the formulation of UK (and devolved) primary legislation. With regard to radioactive waste management and radioactive discharges, the relevant legislation is RSA'93 which invokes a permissive regime in which Agencies authorise certain practices through conditions and limitations attached to authorisations and registrations to use radioactive substances at nuclear licensed and non-nuclear sites (see Section 3.3).

The connection between RSA'93, BPM and certain of the overarching environmental objectives (such as radiological protection of the public) is explained in a number of Government policy and international guidance documents, as discussed below.

3.1.2 The UK National Discharge Strategy

The concept of BPM features prominently in the UK strategy for radioactive discharges [Defra, 2002a]. In particular, the strategy states that:

- BPM is the mechanism for keeping public radiation doses ALARA; and
- applying ALARA/BPM will reduce discharges sufficiently to achieve the OSPAR objective for 2020 of adding 'close to zero' to 'historic levels' of artificial radionuclides in the marine environment.

Similar statements are made in Cm 5552. Specifically, this states that if the operator is using BPM to control discharges then radiation risks to the public and the environment will be ALARA.

The discharge strategy document [Defra, 2002a] and Cm 5552 recognise that it is discharges, not doses, that are able to be controlled directly by operators, so the

'means' in BPM necessarily applies to discharges. Strictly, the ICRP'60 definition of ALARA applies to doses, rather than discharges, because the acronym originates from the principle of the optimisation of protection of people from radiation [CEC, 1996a]. A BPM study normally would involve factors beyond those related to radiological protection of people. An important practical implication of this is that, for regulatory purposes, there is no need to do separate BPM and ALARA studies when considering discharges: one BPM study will suffice.

The discharge strategy document implies that it is the continual application of BPM that is expected to deliver the 'progressive and substantial reduction' of discharges and, therefore, to achieve the strategy's targets [Defra, 2002a]. Whether this approach will be successful will depend on how the Agencies impose BPM requirements on operators, as well as on factors such as rates of progress with decommissioning nuclear licensed sites. The discharge strategy is to be reviewed about every four years and, in principle, the targets could be adjusted upwards or downwards to reflect changes in circumstances.

3.1.3 As Low As Reasonably Achievable (ALARA) and As Low As Reasonably Practicable (ALARP)

The system of radiological protection, as described in ICRP'60, is based on the three basic principles (i) justification of a practice, (ii) optimisation of protection, and (iii) individual dose and risk limits. The optimisation of protection for practices is described as:

"In relation to any particular source within a practice, the magnitude of individual doses, the number of people exposed, and the likelihood of incurring exposures where these are not certain to be received should all be kept as low as reasonably achievable, economic and social factors being taken into account. This procedure should be constrained by restrictions on the doses to individuals (dose constraints), or the risk to individuals in the case of potential exposures (risk constraints), so as to limit the inequity likely to result from the inherent economic and social judgements".

This description of the optimisation of protection, introducing the term ALARA, focuses on individual doses and refers to risks assessed using the dose/risk relationship recommended by the ICRP. ALARA has proved to be an effective tool for managing human risks after low dose exposures taking into account individual doses, the number of exposed individuals and the likelihood that an exposure situation will occur.

Based on ICRP recommendations, a linear relationship between the risk of harmful effects and the radiation dose is assumed at low doses. Theoretically, the dose can always be further reduced. However, this will lead to an increased cost. Accordingly, there is an optimum protection level in terms of additional risk and cost. ALARA as it is currently formulated by ICRP focuses on optimising the protection of humans, not explicitly considering possible effects on non-human species.

The ICRP recommendations are adopted in the BSS Directive and are subsequently transcribed into UK health and safety legislation using the terms ALARP (As Low As Reasonably Practicable) and SFAIRP (So Far As Is Reasonably Practicable). Hence, for the purposes of radiation protection

legislation, ALARA, ALARP and SFAIRP can be regarded as essentially the same in terms of requirements [Bacon et al., 2003]. The same requirements of the BSS Directive are transcribed into UK environmental legislation which requires exposures to members of the public and the population as a whole resulting from the disposal of radioactive wastes to be kept ALARA, economic and social factors being taken into account. As described earlier, the Agencies consider that the application of BPEO and BPM ensures doses are kept ALARA.

Concerns expressed by the nuclear industry that different regulatory application of ALARP (by the HSE) and BPM (by the Agencies) in nuclear safety and environmental protection were causing some conflicts. There followed a review of the working relationship between the HSE and EA and the signing in 2001 of a Statement of Intent. This provides an explanation of the HSE and EA responsibilities for nuclear safety and environmental regulation on and around nuclear licensed sites and the ways in which the two regulators carry out their regulatory activities. It also lists areas of joint regulatory interest and the ways in which HSE and EA interact on that work. Subsequently HSE and EA have produced a joint report called 'Working Together' [HSE and EA, 2003] on work they have done to follow up the statement of intent. Industry-wide workshops leading to the drafting of 'Working Together' concluded that problems arose if safety (ALARP) and environmental protection (BPM) were considered separately and that a truly optimised regulatory position could only be achieved if ALARP and BPM are considered together from the very start of the regulatory position.

SEPA is currently considering its position on the Statement of Intent.

3.1.4 Draft Statutory Guidance on the Regulation of Discharges from Nuclear Sites

In 2000 Defra (then DETR) and the Welsh Assembly undertook a consultation on draft statutory guidance to the EA on the regulation of radioactive discharges into the environment from nuclear licensed sites in England and Wales [DETR, 2000; Welsh Assembly, 2000]. This guidance is expected to be finalised over the next year or so. The Scottish Executive is also likely to issue statutory guidance to SEPA on this topic in due course.

The emphasis on BPM in the draft statutory guidance is not identical to that in the discharge strategy document, but it is possible that this may be altered in the final versions in light of the consultation responses. The draft statutory guidance document states that '*BPM should be used to ensure that discharges are ALARA, social and economic factors having been taken into account*'. This statement is not exactly consistent with later Government documents which take the view that BPM applies to discharges and ALARA applies to doses (see Defra [2002a] and Cm 5552). The draft explanatory memorandum to accompany the guidance states that '*BPM and ALARA are essential elements of the regulatory process and are consistent with the application of the precautionary principle*'. While BPM can be applied so as to be consistent with the precautionary principle, it is more difficult to see how this can be achieved for ALARA.

More generally, it is not clear why the draft statutory guidance links BPM only to ALARA and the precautionary principle. The view expressed in the draft EA guidance on limit setting [Hill and Kerrigan, 2003] is that the application of BPM is best viewed as an approach to be used in implementing specific environmental protection principles, discussed earlier in Section 3.1.1.

The draft statutory guidance also states that there is always a preference for 'concentrate and contain' over 'dilute and disperse'. This should influence the choice of options to compare in BPM (and BPEO) studies. In general, it means that more attention should be paid to identifying those new options with a greater element of 'concentrate and contain' than to those with more 'dilute and disperse'. This is not to say that 'dilute and disperse' should be neglected entirely. It is important to include it, not least as a baseline against which other options can be judged, as it may influence the choice between options.

3.2 Related environmental protection concepts in UK legislation

There are a number of environmental protection concepts that relate to BPM that are referred to in RSA'93 and Cm 2919 in the context of radioactive materials, and other regulations and guidance documents in the context of non-radioactive materials. Chief amongst these are the concepts of BPEO and BAT.

3.2.1 BPM and BPEO

BPEO features as a standard condition in authorisations for nuclear licensed sites that requires:

'the operator shall provide the regulator with a full report of a comprehensive review of whether the current disposal routes continue to represent the BPEO for waste disposal from the site, together with a programme for carrying out any necessary changes identified by the review'.

There is sometimes confusion between BPM and the concept of BPEO which, as discussed in Section 3.1, originates in the recommendations of the RCEP [RCEP 1976 and 1988]. As is made clear in Cm 2919, the assessment of BPEO is used to decide on a waste management option, whereas the application of BPM determines how that option is carried out. Put colloquially, BPEO is about doing the right thing and BPM is about doing it the right way. The Agencies have issued stand-alone guidance to their staff on BPEO in relation to radioactive waste management at nuclear licensed sites [EA, 2004]. This guidance makes it clear that BPEO is primarily relevant to strategic decisions on radioactive waste management.

Agencies require operators to implement both BPEO and BPM to the management of radioactive wastes. The Agencies' view is that both BPEO and BPM must be applied throughout the waste hierarchy to ensure that wastes are not generated unnecessarily and that those arisings that do occur are either reused or recycled in preference to being disposed. From the definitions above it is clear that, for new waste management operations, the BPEO study is to be carried out first, followed by the BPM study, because the first decision is about which waste management option to adopt and the second about how that waste management option should be implemented and optimised.

The situation is not quite so clear cut for existing operations. Generally, the Agencies would expect to satisfy themselves that the operator continues to apply BPM through the implementation of an appropriate improvement programme. Such improvement programmes would be expected to result in incremental improvements to the way that radioactive waste management operations are carried out and discharges are reduced. Additionally the Agencies may wish to

satisfy themselves that the waste management option being used by the operator still represents the BPEO.

It is possible to envisage situations in which such a BPEO review is not deemed necessary (e.g. because a current operation will cease in a few years and there would not be time both to perform the review and to implement a new option). There may also be occasions when the BPEO review and BPM study can be combined by the operator into one study which examines both variations on the existing options and alternative options.

If BPEO and BPM are applied to a set of processes, facilities and methods of operation, then it is considered that radiation risks to the public and the environment will conform to the ICRP principle of ALARA.

If the BPEO and BPM reviews are combined then the BPEO guidance should take precedence, particularly with respect to stakeholder participation in the study. Only in exceptional instances would stakeholders other than the operator and Agency staff be directly involved in a BPM study. It is foreseen that many BPEO studies, and certainly all large scale ones, would involve other stakeholders.

There is no formal requirement on non-nuclear licensed sites to undertake a BPEO study for new operations or to undertake BPEO reviews for existing operations. Nonetheless, the strategic intent of BPEO studies should not be lost when non-nuclear sites undertake their BPM studies and reviews. As a result, they should ensure that they consider a sufficiently wide range of process and management options in their BPM studies to ensure that the best option from the widest range of alternatives is implemented.

3.2.2 BPM and BAT

The concept of BAT is now used in European law on non-radioactive pollutants [CEC, 1996b] and in the UK regulations that implement those laws. BAT is defined in the Pollution Prevention and Control (PPC) Regulations 2000 as follows.

'Best available techniques' means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole;

'available techniques' means those techniques that have been developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the cost and advantages, whether or not the techniques are used or produced inside the United Kingdom, as long as they are reasonably accessible to the operator;

'best' means, in relation to techniques, the most effective in achieving a high general level of protection of the environment as a whole;

'techniques' includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

The PPC Regulations also state that, in assessing BAT, special consideration shall be given to the following matters, bearing in mind the likely costs and benefits of a measure and the principles of precaution and prevention:

- the use of low-waste technology;
- the use of less hazardous substances;
- the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate;
- comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
- technological advances and changes in scientific knowledge and understanding;
- the nature, effects and volume of the emissions concerned;
- the commissioning dates for new or existing installations or mobile plant;
- the length of time needed to introduce the best available technique;
- the consumption and nature of raw materials (including water) used in the process and the energy efficiency of the process;
- the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it; and
- the need to prevent accidents and to minimise the consequences for the environment.

The definition of BAT in the OSPAR convention is similar to that in the PPC Regulations and the statements made in the convention about 'best environmental practice' are similar to those in the PPC Regulations about the factors to be considered in assessing BAT.

It is important that there is an appropriate degree of consistency between the Agencies' approach to radioactive pollutants and the approach to non-radioactive pollutants. To achieve this, the application of BPM and BPEO at sites that discharge radioactive substances into the environment should be broadly equivalent to the application of BAT at sites that discharge non-radioactive pollutants.

3.3 The role of the Agencies

The Agencies are charged with enforcing the requirements of RSA'93 and do this through the inclusion of specific conditions and limitations in the registrations and authorisations granted that require operators to use BPM to minimise waste arisings and discharges. In support of its environmental protection role, the Agencies have defined views on BPM and definitions of what the term BPM represents.

3.3.1 The environment agencies' view of BPM

As mentioned earlier, the Agencies consider BPM to be a means of engendering a culture of environmental protection with respect to the management of radioactive substances. Thus, the Agencies view is that BPM and BAT are synonymous (see list in previous section) and aim to achieve the same end result of balancing costs to the operator against environmental benefits by means of a logical and transparent approach to identifying and selecting processes, operations and management systems to reduce discharges.

As with BPEO, BPM embodies the concept of 'best practicable'. In this context, 'best' is interpreted by the Agencies to mean options which, when applied by the site operator, are the most effective in achieving a high general level of protection of the environment as a whole and 'practicable' is interpreted to mean 'reasonably practicable'.

An option will be regarded by the Agencies as reasonably practicable if it is currently available, or is capable of being developed, on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into account the costs and benefits. This will apply whether or not the option is currently used in the UK, as long as it is reasonably accessible to the operator. The Agencies' take the following views on 'best practicable':

- for new facilities, 'best practicable' equals best available practice at the relevant scale in the UK or abroad;
- for existing facilities, the standard for new facilities sets a benchmark;
- standards and Guidance as produced, for example, by national bodies such as the National Radiological Protection Board (NRPB) and by international bodies such as the International Atomic Energy Agency (IAEA) play a part in defining what is 'best practicable';
- what has recently been done, and accepted by the Agencies, at similar facilities is an important source of what is currently to be regarded as 'best practicable'; and
- what is 'best practicable' is likely to change over time.

In assessing BPM, it is the Agencies policy not to require operators to expend effort, whether in time, trouble or money, that would be disproportionate to the resulting benefits (benefits such as a reduction in the amount of radioactive wastes created and a reduction in the impact of discharges on people and the environment). There are, however, slight differences in terminology between various relevant documents. Both Cm 2919 and the interim EA guidance to non-nuclear users [EA, 2002] state that the operator's effort should not be 'disproportionate' to the benefits. In contrast, the draft statutory guidance [DETR, 2000] and recent authorisations under RSA'93 use the phrase 'grossly disproportionate', whilst the UK discharge strategy [Defra 2002a] uses both 'disproportionate' and 'grossly disproportionate' interchangeably.

The most appropriate policy for the Agencies to adopt in future appears to be that effort should not be 'grossly disproportionate' to benefits. This gives scope to the

Agencies to require operators to spend more or to focus its available resources (e.g. manpower, equipment etc.) where doing so will lead to progressive and substantial reductions in discharges to align with the UK national discharge strategy. Additionally this approach would make the Agencies' application of BPM consistent with the HSE(NII)'s application of 'as low as reasonably practicable' (ALARP) and resolve concerns expressed by some stakeholders about potential differences in standards [DTI, 2002; Defra, 2002b].

Whilst it is the Agencies policy not to require operators to devote effort to a BPM study that would be disproportionate to the likely benefits there is no numerical limit or threshold of discharge, disposal, dose or environmental contamination below which BPM does not apply (see Section 2.2). It is not possible to define in advance clear criteria which could be used by the Agencies in deciding what is 'grossly disproportionate' or 'disproportionate' in terms of how they translate as conditions in to RSA authorisations. It is noted that neither the Agencies nor the HSE(NII) have defined any formulation for evaluating the size of the gross disproportion factor for a given level of risk.

3.3.2 BPM in authorisations granted under RSA'93 to nuclear licensed sites

The HSE(NII) has responsibility under the statutory provisions of the Nuclear Installations Act 1965 (as amended) which enables HSE to attach conditions to the nuclear site licence in the interests of safety, or which HSE think fit, with respect to the handling, treatment of nuclear matter, including radioactive waste. The Agencies have responsibility under the statutory provisions of RSA'93 for the disposals of radioactive waste on or from nuclear licensed sites.

All new authorisations for nuclear licensed sites granted by both the EA and SEPA will, in future, be based on a common template multi-media certificate of authorisation and will contain a number of conditions relating to BPM. These conditions are detailed in Appendix V but, in summary, require an operator to use BPM to minimise:

- the activity of radioactive waste produced that will require disposal under the authorisation;
- the activity discharged to the environment;
- the volume of radioactive waste transferred to another site; and
- the radiological impacts to people and the environment due to disposals of radioactive waste.

In addition, the authorisation requires the operator to use BPM when taking samples and conducting measurements, tests, surveys and calculations to determine compliance with the limitations and conditions of the authorisation.

Other specific conditions may be included in an authorisation that require the operator to use BPM for additional purposes.

The Agencies set out their interpretation of BPM in the certificates of authorisation as:

'In determining whether particular means are the 'best practicable' for the purposes of this Authorisation, the Operator shall not be required to incur expenditure whether in money, time or trouble which is, or is likely to be, grossly disproportionate to the benefits to be derived from, or likely to be derived from, or the efficacy of, or likely efficacy of, employing them, the benefits or results produced being, or likely to be, insignificant in relation to the expenditure.

Where reference is made to the use of 'best practicable means' in this Certificate of Authorisation, the means to be employed shall include:

- the provision, maintenance and manner of operation of any relevant plant, machinery or equipment;*
- the supervision of any relevant operation.'*

Within the condition, the phrase *'expenditure of time, money or trouble'* is a legal phrase derived from case law and is central to the concept of proportionality which underpins BPM.

For existing plant and processes, the Agencies will require the operator to make progressive improvements in waste management methods and reductions in discharges, and production and disposal of other radioactive waste. The standard conditions thus require the application of BPM on a continuing day-to-day basis and, to demonstrate compliance with the conditions, the Agencies may require the operator to carry out BPM studies for particular plants or operations on the site, and the Agencies require the operators to provide them with:

'a full report of a comprehensive review of national and international developments in best practice for minimising all waste disposals, together with a strategy for achieving reductions in discharges'.

This review and strategy are directly relevant to the Agencies assessment as to whether the operator's current plant and practice represent the BPM.

The consideration of BPM in setting discharge limits for nuclear licensed sites is addressed in draft EA guidance to its inspectors [Hill and Kerrigan, 2003]. The guidance states that the Agencies' BPM assessments would typically be carried out between the regular reviews of authorisations. The outcomes of the BPM studies would feed into the review of the authorisation and contribute to the setting of discharge limits.

Judgement as to whether or not the operator is using BPM to minimise discharges is generally exercised on the level of discharge achieved. All new authorisations under the multi-media template will set quarterly notification levels (QNLs) on discharges. If a QNL is exceeded, the operator must provide the Agencies with a review having regard to the requirements placed on the operator to use BPM.

3.3.3 BPM in registrations granted under RSA'93 to non-nuclear sites

The conditions and limitations included in authorisations granted by the Agencies to non-nuclear sites are detailed in Appendix V.

Since November 2003, the EA has included a requirement in all non-nuclear authorisations granted that the users of radioactive material shall employ BPM to:

- (a) minimise the activity in all disposals of radioactive waste;*
- (b) where requested for authorisation, minimise the volume of radioactive waste disposed of by transfer to other premises;*
- (c) dispose of radioactive waste at times, in a form, and in a manner so as to minimise the radiological effects on the environment and members of the public.*

Prior to this decision, in November 2002 the EA issued interim guidance on BPM for non-nuclear users [EA, 2002]. The guidance outlines what the user is expected to do to demonstrate that BPM are being or will be applied. This involves reviewing current and planned practices, assessing possible changes to them, and providing the EA with such appropriate documentation. Additional guidance is currently being prepared.

SEPA has recently introduced standard conditions relating to BPM in new certificates of authorisation for the accumulation and disposal of radioactive waste by users on non-nuclear sites which require that:

'BPM shall be used to minimise the volume and activity of authorised waste produced; and

BPM shall be used to minimise the activity of authorised waste disposed or discharged'.

There is currently no specific BPM condition associated with registrations granted by SEPA under RSA'93 but there is a condition for waste minimisation and adherence to this condition is considered by SEPA to represent BPM. SEPA has amended its registration certificates for the keeping or use of radioactive material to include a requirement that BPM be used to ensure that no unnecessary radioactive waste is generated. To this effect a clause has been added in certificates about the keeping and use of sources that states "*The Registered Person shall take all practicable measures to ensure that unnecessary radioactive waste is not generated as a result of the keeping or use of the registered substances*".

In Northern Ireland, the Chief Radiochemical Inspector has introduced standard conditions relating to BPM in new Certificates of Authorisation on non-nuclear premises which require that:

'The user shall use BPM to minimise the activity of radioactive waste produced that will require disposal under the Certificate of Authorisation.

The user shall use BPM to:

- minimise the activity of gaseous and aqueous radioactive waste disposed of by discharge to the environment;*
- mitigate the radiological effects of any discharge on the environment and members of the public; and*

- *minimise the volume of radioactive waste disposed of by transfer to other premises.'*

3.3.4 BPM and its role in strategic waste management

As stressed earlier, the Agencies view BPM as a means of engendering a culture of environmental protection with respect to the management of radioactive substances. The Agencies are, however, concerned with protection of the environment from all hazards and impacts, both radiological and non-radiological.

To ensure that operators of nuclear sites apply consistent approaches to environmental protection in relation to both radioactive and non-radioactive wastes, the EA and SEPA are planning to include a new standard condition in authorisations for nuclear licensed sites that will require the operator to develop an Integrated Waste Strategy (IWS).

An IWS will be a plan to ensure that waste management approaches are both optimised and applied consistently across a site (or multiple sites) to all actual and potential sources of waste, both radioactive and non-radioactive, as well as materials that may become waste in the future. It will need to address what wastes are disposed of to the environment, what wastes are required to be stored, as well as waste minimisation issues. Both on-site and off-site considerations will be addressed in an IWS, and this will require a nuclear licensed site to take best advantage of existing waste management facilities elsewhere in the UK. Specifically, when formulating an IWS, a site will need to develop policies and strategies, including principles, that explain how they will manage their wastes so that:

- wastes are stored and treated in processes that represent ALARP;
- any disposals represent BPEO with associated BPM abatement and monitoring arrangements;
- decommissioning plans are prioritised with respect to safety, health and the environment;
- the operator can demonstrate compliance with regulatory requirements; and
- that all of the above is to the satisfaction of the stakeholders.

Both SEPA and the EA consider an IWS to be optimised when it is the outcome of a systematic and consultative decision-making process that has considered a range of options and their practicability. It is anticipated that a strategic BPEO study would be required to identify an optimised strategy and to ensure that options for waste minimisation, and waste reuse and recycling are given precedence over options for waste disposal. In order to ensure a high level of environmental protection through the application of an IWS, effective management systems are required. A full environmental management systems (EMS) is not, however, always required. Instead, Agency staff should consider the operator's competence and other aspects of the site and plant management including its internal work procedures. Management arrangements are therefore an integral part of BPM.

4 ADVICE TO AGENCY STAFF

The following sections set out advice to support the Agencies' assessment of operators' BPM studies relating to the registration or authorisation of radioactive substances. Specifically, the advice relates to a number of key issues that Agency staff may need to consider when determining an operator's BPM assessment, as follows:

- the application of BPM to different types of site and process;
- assessing how an operator complies with the BPM conditions and limitations in their authorisations or registration;
- assessing an operator's BPM study and associated documentation;
- making a final assessment on an operator's use of BPM; and
- providing general advice and information to the operator.

The advice has been developed from considered views based on the outcome of the consultation processes and other work undertaken as part of this project.

4.1 The application of BPM to different types of site and process

The advice that follows is intended to apply at all sites for which conditions and limitations pertaining to BPM are included in authorisations and registrations granted under RSA'93 to control airborne and liquid discharges, and disposals of solid wastes. It is recognised, however, that BPM is applied differently on nuclear and non nuclear licensed sites, taking into account the different practices being used and also the different economic and social considerations that must be taken into account.

The consultation process did consider whether separate guidance was required for different types of site. Many of the non-nuclear sites requested separate guidance, and some Agency staff supported this view but not universally. In the end it was decided that a single set of advice would be appropriate because RSA'93 makes no distinction between nuclear licensed and non-nuclear sites, and the fundamental principle of BPM is equally applicable to all sites with regard to environmental protection.

That said, it is recognised that the operations and circumstances on a nuclear licensed site may be very different to those on a non-nuclear site, similarly between decommissioning and operating nuclear licensed sites. The following text is, therefore, intended to provide some advice to Agency staff to help them tailor their approach to enforcing the use of BPM in different circumstances.

It is stressed, however, that while all practices involving radioactive materials on both nuclear licensed and non-nuclear sites must be justified, justification arguments themselves should not be included in a BPM study and are a matter for Government.

4.1.1 Non-nuclear sites

The requirement for non-nuclear sites to use BPM is a standard condition that is included in all new authorisations granted by each Agency (see Section 3.3.3). Interim guidance from the EA on the application of BPM at non-nuclear sites in England and Wales has been made available to Agency staff and operators [EA, 2002] to help to support all parties to meet the demands of the new BPM conditions and limitations in authorisations. The intent of that interim guidance has been incorporated into this report. Both the EA and SEPA support small user liaison groups (SULG) and these groups are used to promulgate good practice for the implementation of BPM.

The practices undertaken on non-nuclear sites are usually substantially different to those of nuclear licensed sites. On non-nuclear sites the use of radioactive materials is usually to support some other primary objective (e.g. to enhance clinical treatments or to allow certain analyses to be made). Other primary demands on a non-nuclear site, such as to achieve greater rates of cancer treatment, may require the operator to propose an increase in their total discharges. Agency staff should confirm whether such proposals are in line with Government policy and, if so, such proposals may be considered allowable provided that it is demonstrated adequately that national and international limits and constraints on radiation exposures will be complied with. Nonetheless, in all cases, Agency staff should ensure that all potential impacts are identified and quantified in the operator's BPM study, and that appropriate options are identified and assessed for reducing the greatest environmental risks.

In many cases, but not all, non-nuclear sites have limited flexibility to adopt strategically different practices to improve their management of radioactive materials because of other constraints that act upon them. These constraints could include practical issues such as the need not to compromise clinical imperatives, the need to meet the Government's targets for cancer treatment, the difficulty in retrofitting plant to existing facilities in urban locations and resource limitations. Since there is no requirement on non-nuclear sites to undertake a BPEO study, it is important that they consider a sufficiently wide range of practices, including strategically different alternatives, in their BPM studies to ensure that the best option from the widest range of alternatives is implemented.

It will not always be the case that there are no or only a few strategically different practices for managing radioactive materials available to a non-nuclear site. As such, Agency staff should ensure that the operator has provided suitable arguments for the range of practices considered in the BPM study. In all cases prevention and minimisation should be carried out to the maximum reasonable extent.

The requirement for doses to be ALARA applies to non-nuclear sites and is included as conditions and limitations in authorisations to ensure disposals of radioactive waste are minimised. In simple terms, the ALARA principle requires operators to apply BPM to minimise discharges and do so in a manner that is not unreasonably costly. In many cases this is not done explicitly but rather by the use of relevant good practice. In other cases, where relevant good practice is less evident or not fully applicable, the onus is on the site operator to implement BPM to the point where the costs of any further measures would be grossly disproportionate to the risks they would reduce.

An operator may in their BPM study identify as a preferred practice one that requires limited expenditure (in money, time or trouble) because they have included in their cost and benefit (proportionality) analysis some additional benefit from the activities they perform. For example, a hospital may wish to justify implementing a cheaper, less effective practice for minimising discharges because to do otherwise may divert resources away from clinical activities that could benefit the public. Agency staff may bear such arguments in mind when evaluating the operator's BPM study but must consider that such arguments do not alone justify a 'do nothing' or 'do the minimum' approach from the operator. Since there are no fixed guidelines on the application of proportionality in such circumstances, Agency staff are advised to make comparisons with what has recently been done, and accepted by the Agencies, at similar facilities elsewhere, since this is an important source of assessing what is currently to be regarded as 'best practicable'. Nonetheless, BPM is considered to evolve over time as technology and policy develops and, thus, consideration of these issues must be made when comparing with what has been done elsewhere.

In some cases, the documentation presented by the operator as the basis to justify the practice, and other quality procedures and systems already in place, may all be used by the operator as part of their BPM study. Similarly, information first compiled to demonstrate to the HSE(NII) the health and safety of workers, staff and the public may be used as part of the operator's BPM study. Thus, it is not always necessary for the operator to undertake a separate BPM study but to look across at other complementary studies and draw on these. In all cases, the length, detail and complexity of the BPM documentation produced should be proportionate to the issue at hand, and concise and unambiguous documents are always to be preferred.

4.1.2 Decommissioning nuclear licensed sites

Decommissioning is currently viewed by the Agencies as an extension of the original purpose of the practice and one that may or may not involve new plant (e.g. plant to be constructed for the treatment of legacy wastes) but is likely to be carried out to reduce hazards from the site. It is likely to result in different quantities and characteristics of waste arisings. Agency staff should be aware that it is sometimes impractical for a decommissioning site to achieve year-on-year reductions in discharges and, in some cases, discharges may need to increase temporarily, as discussed below.

Nonetheless, the principle of BPM would apply equally to a decommissioning site as to one that is still operating. Thus, Agency staff should still require an operator to use BPM to reduce waste arisings and discharges where it is reasonably practicable for them to do so.

With regard to the requirement to use BPM for waste minimisation, a much greater emphasis may be placed by the Agencies on this issue when a site enters its decommissioning phase because of the increased potential for solid waste volumes to be generated when materials from contaminated facilities, plant and land need to be managed. When evaluating the options considered in the operator's BPM study (and BPEO study), Agency staff should seek to ensure that a sufficiently wide range of means has been considered in line with the concept of the waste hierarchy, including means for recycle and reuse of the materials, and decontamination and segregation, rather than simply means for bulk waste

disposal. Agency staff should also favour those means proposed or implemented by the operator that apply 'concentrate and contain' over 'dilute and disperse'.

With regard to the requirement to use BPM to minimise discharges, the operator may propose implementing means during decommissioning that entail an increase in liquid or gaseous discharges. When evaluating the operator's BPM study (and BPEO study), Agency staff should confirm whether such options are in line with Government policy and provisions in the discharge strategy and, if so, such proposals may be considered allowable provided that it is demonstrated adequately that:

- national and international limits and constraints on radiation exposures will be complied with;
- all increases are temporary, for a defined and limited period of time, and result in a general downwards trend after the early phases of decommissioning; and
- there is an overall reduction in the long-term risk from the site.

This view is consistent with the draft guidance on discharge limit setting to EA inspectors [Hill and Kerrigan, 2003]. Nonetheless, an operator cannot simply justify implementing an option that results in increases in discharges simply on the basis of provisions in the discharge strategy, and Agency staff should still seek a demonstration that for the operator to implement alternative waste and discharge minimisation options would incur grossly disproportionate expenditure (in either money, time or trouble). In regard to decommissioning programmes, Agency staff may wish to apply campaign limits to control discharges where temporary increases in discharges are proposed.

4.1.3 BPM applied to new plant and existing plant

It is likely that the Agencies will need to take a different approach to assessing an operator's BPM study for a proposed new plant or process (or substantial modification of existing facilities) that represents a new practice involving the creation or disposal of radioactive waste, than they will for an existing plant or process.

For an existing plant or process, BPM is assessed by comparing what means are currently used to control radioactive substances with those that would be applied to a new plant or process. This benchmarking allows the operator to subject any shortfalls to the test of what is reasonably practicable. The onus is then on the operator to implement those controls set by the benchmark unless the costs of doing so are grossly disproportionate to the benefits. It is the Agencies view that the means is reasonably practicable unless its costs are grossly disproportionate to the benefits. One way of demonstrating that the gross disproportion test is adhered to is to undertake a cost benefit analysis.

In the case of proposed new plant or process, operators should be encouraged to discuss their plans with the Agencies at an early stage. Doing so should help streamline the BPM process, and minimise the financial and project risk to the operator of failing to gain regulatory support for their plans. As part of these discussions, the Agencies may require the operator to submit a BPM study to them for assessment in advance of the plant or process being commissioned. For

significant new developments, Agency staff may require that a BPM study is undertaken at the conceptual design stage and they may also wish to be consulted on the environmental factors to be considered in that study. In most cases on a nuclear licensed site, this BPM study will follow a BPEO study that defines the strategic waste management approach the operator wishes to adopt. This will not be the case at non-nuclear sites where there is no BPEO requirement.

Where installations are not particularly complex or novel, the operator should usually be able to undertake a BPM study at the design stage for a new plant or process that contains all the information Agency staff will need to make an assessment. This would include proposals for management of the installation and training of operational staff.

The onus is on the operator to assess the effects of their operations, to explore ways of improving them and to make proposals for consideration by Agency staff. For more complex new plant or processes, a staged BPM study may be appropriate. Once Agency staff and the operator decide in principle to proceed with a staged submission, they should look to agree a plan for the full application. The plan could be submitted in stages as the operator progressively develops the design plans.

The Agencies are unable to provide 'stand-alone approval' for an operator's BPM study. The operator's application of BPM on a site will be assessed by Agency staff in terms of their overall compliance with the limitations and conditions in their authorisation (see Section 4.2). It would be good practice, however, and inline with the principle of 'better regulation' for Agency staff to make an operator aware of any aspects of their BPM study that they find unsuitable, particularly if a staged submission for a proposed new plant or process has been agreed with the operator.

In the case of an existing plant or process, the operator should undertake a periodic BPM review, without being prompted by Agency staff, and the emphasis in that review should be on evaluating whether the current operations remain BPM in the light of technological developments, policy reviews, new information etc. If not, an appropriate improvement programme should be identified to ensure that BPM are achieved. The Agencies consider that a BPM review is a key requirement of the overall BPM compliance process and should demonstrate that BPM is being applied to optimise control over radioactive substances on a continuous basis.

It is clear that the outcome of a BPM study on an existing plant may differ from that of one on a new plant which carries out the same operation. There may be few practical options available to the operator for modifying existing plant, or modifying the way in which it is operated, so as to reduce waste arisings and discharges. It may also be more expensive to retrofit features to an existing plant than to include them in the design for new plant, or the risks to the workforce of retrofitting may increase [HSE, 2001b].

In all cases, however, Agency staff should first seek to ensure that a sufficiently wide and imaginative range of options has been considered by the operator and then that the operator has justified their choice of option through appropriate cost-benefit proportionality arguments. Again, since there are no fixed guidelines on the application of proportionality in such circumstances, Agency staff are

advised to make comparisons with what has recently been done, and accepted by the Agencies, at similar facilities elsewhere, since this is an important source of assessing what is currently to be regarded as 'best practicable'.

The process applied by the Agencies for assessing BPM will be the same for existing installations as for new ones. The final standards implemented by the site operator may, however, be different. In general terms, the Agencies will primarily be concerned with establishing timescales for upgrading existing installations to new standards, or as near to new standards as possible. How far the new plant standards apply will depend on local and plant specific circumstances. A simple example could be an existing installation that operates very close to what can be considered BPM for a new installation but it uses different plant or processes. Replacing the old plant with the new techniques may produce only a small decrease in discharges but incur a large cost. Therefore the change would not be proportionate. However, if the operator were to carry out a major modification anyway for other purposes (e.g. to increase productivity) the new plant standards might be applicable.

4.1.4 Fault situations

Operators should consider BPM in relation to fault situations as well as normal operations.

Regulatory control for 'foreseeable' faults on a nuclear licensed site rests with the HSE(NII) with regard to plant and process design, and for emergency response. On a non-nuclear site, however, regulatory control rests with the Agencies and they should therefore seek to ensure that operators have applied BPM to minimise both the likelihood and consequence of a fault. As a simple example, in the case of fire on a non-nuclear site there may be a potential hazard from contaminated firewater reaching the open drains or contaminating ground and surface waters. As part of the facility design, BPM should be identified and used to contain the firewater. This may involve, for instance, construction of bunds or fitting of valves to drainage systems

With regard to 'unforeseeable' faults, the requirement to use BPM still applies for all sites and should be considered in the development of emergency response plans. When drawing-up emergency response plans, the operator should be aware that the ICRP'60 principle of optimisation of protection would still apply (see Section 3.1.3) and, therefore, radiation exposures to public and workers should be kept as low as reasonably achievable. Emergency response plans should, thus, be designed to incur minimal releases of activity to the environment, so far as is reasonably practicable and without restricting the ability of response teams to deal successfully with the emergency.

4.2 Assessing how an operator complies with the BPM conditions in their authorisations or registration

The standard conditions and limitations of an authorisation require an operator to minimise the activity of radioactive waste produced, and to minimise the volume and activity discharged to the environment. Thus, an operator should apply BPM to all of their activities that involve the handling of radioactive substances, across all of their plants and process.

As part of their normal inspection programme, Agency staff should seek to satisfy themselves that an operator is applying BPM comprehensively in compliance with the conditions and limitations of RSA'93 registrations or authorisations. Judgement as to whether or not the operator is using BPM to minimise discharges is generally exercised on the level of discharge achieved. All new authorisations under the multi-media template will set quarterly notification levels (QNLs) on discharges. If a QNL is exceeded, the operator must provide the Agencies with a review having regard to the requirements placed on the operator to use BPM.

It may help to consider the key elements in the BPM decision making cycles (Figures 1 and 2 from Section 2) that an operator should undertake and which Agency staff may use to determine that BPM is being applied in the cases of both nuclear-licensed and non-nuclear sites. These cycles are not fixed, and elements of them may change from case to case, or some elements may be combined, but the main aspects of the cycles would be common to all BPM decisions.

With regard to BPM, Agency staff may interact with the operator differently depending on whether a BPM study is undertaken for new or existing plant and processes.

4.2.1 BPM for proposed new operations

For a proposed new plant or process on a nuclear licensed site (or substantial modification of existing facilities) involving the creation or disposal of radioactive waste, it is likely that a BPEO study will already have been done by the operator to define the strategic approach to waste management that they plan to implement (Figure 1). The start of the BPM process is then a BPM study, which is essentially a desk exercise to optimise the strategy chosen in the BPEO study. On the basis of this study, the operator will decide what plant and process they consider to represent the BPM. The decision should be made using a 'cradle to grave' approach and, thus, the impacts from later decommissioning of new plant should be addressed in the operator's BPM study.

The process by which the study was made, the operator's decision and any other relevant information that supports the operator's decision will need to be recorded in written documentation in a thorough, logical, transparent and auditable manner.

For a proposed new plant or process on a non-nuclear site (Figure 2), a BPEO is unlikely to have been completed because there is no requirement on the operator to do so. In this case, Agency staff must ensure that all strategic alternatives are considered as options in the operator's BPM study (see Section 4.1.1).

As mentioned earlier, in the case of proposed new plant or process on any site, Agency staff may require the operator to submit this BPM study and documentation to them for assess in advance of the plant or process being commissioned.

Whilst Agency staff may request that a BPM study is undertaken and submitted to them, there is no legal obligation on them to provide any advice to the operator on how that study should be performed. If this were taken to extremes, Agency staff could simply require an operator to do a BPM study and then assess what the operator provides. This issue was discussed in the consultation and it was broadly agreed, however, that for the reasons of efficiency and consistency with better regulation, Agency staff should consider providing some advice to the

operator on what is needed or expected. The advice can be given a priori, or in response to operator requests, or both.

Agency staff should consider what is an appropriate level of advice to afford the operator but, as a minimum, should consider discussing with the operator the scope of the BPM study (i.e. which plant, operations, waste streams or radionuclides and other environmental factors it should cover). Depending on the circumstances, Agency staff may require the operator to extend the scope in greater detail or leave some aspects open. In considering the scope of the BPM assessment, Agency staff should take cognisance of the proportionality between the effort involved in undertaking the study and its likely benefits to the environment. It is not, however, considered appropriate for Agency staff to tell the operator what detailed methodology they should use for the BPM study. The operator should have the flexibility to use whatever methodology they see fit but Agency staff would be advised to guide the operator to make their documentation transparent and auditable to aid its assessment.

It is also recommended that Agency staff discuss with the operator a format and schedule for responding to the operator's submission. Although Agency staff have no formal process available to them by which they can 'approve' an operator's BPM study for proposed new plant they should, as appropriate, either inform the operator of any improvements they would seek to ensure BPM are used (should they disagree with the operator's study) or to indicate to the operator that they have no objections to the operator's proposals.

The suggested approach for assessing the operator's BPM study is given in Section 4.3.

4.2.2 Site operator BPM reviews

In general, what represents BPM will change with time both as a result of technological developments and international best practice, and in the light of policy, regulatory and societal changes. From time to time, therefore, to ensure they are in compliance with the requirement to be applying BPM, the operator should undertake a review of their operations to ensure that what is currently implemented remains the BPM. On the basis of these reviews, the operator will either be satisfied that BPM continue to be used or else they will need to implement a programme incrementally to improve the waste management and discharge practices that are in place. The essence of such a review is to investigate possible options which have the potential to reduce discharges or minimise waste creation to see whether any could be implemented without incurring disproportionate costs.

4.2.3 Agencies initiated BPM reviews

The Agencies may ask an operator at any time to review its approach to demonstrate compliance with the BPM conditions in its authorisation. Specifically, a review may be requested in cases where:

- another plant or site is known to be using a different technology or process, for the same purpose, that achieves lower discharges;
- data returns show that discharge or disposal limits are near prescribed limits (i.e. there is minimal headroom); or

- for non-nuclear sites, other less-active isotopes could be used.

In addition, the EA has included in its standard authorisation for nuclear licensed sites a requirement for the operator to undertake a single or periodic review of relevant best practice, including international best practice. Such a review will be expected to examine a range of options, including both technical and management aspects, and demonstrate that BPM have been chosen on the basis that the costs of further improvements would be grossly disproportionate to the benefits of such improvements.

As part of their normal inspection programme, Agency staff will seek to satisfy themselves that an operator is applying BPM for existing operations in compliance with the conditions and limitations of their authorisation. In so doing, Agency staff can examine the methods used by an operator for undertaking BPM studies and reviews, and their associated documentation, as well as evaluating the operator's decision on what constitutes BPM and any improvements that are implemented. Particularly when reviewing technologies, Agency staff should look for a demonstration that the operator has undertaken a technology review, and considered both UK and international best practice.

Agency staff need not expend effort during their inspection that would be disproportionate to the issue at hand. When conducting their inspection it would not, in most cases, be necessary for Agency staff to examine every aspects of the operator's BPM documentation but they should seek to satisfy themselves that the operator is implementing BPM through sampling of a representative number of documents. Agency staff may wish to inspect some or all of the following:

- the operator's management system, organisational structure and resources which should be sufficient to achieve compliance with the limitations and conditions in their authorisation;
- a schedule for performing BPM studies and any associated BPEO studies, and recorded progress against that programme; and
- documentation supporting those BPM studies that have been completed and any improvement programmes that are subsequently implemented.

The documentation provided to Agency staff should indicate how the site ensures their BPM conditions and limitations in their authorisation are complied with through the implementation of structured working procedures that define when and by what method BPM studies are required to be performed, so that they are undertaken routinely and consistently across the site. There is no requirement for Agency staff to comment on the operator's documentation but the operator may find it easier to demonstrate compliance with all of their conditions and limitations of authorisation if the documentation is summarised by a 'compliance map' that provides a structured route through the relevant documentation.

Agency staff will need to satisfy themselves that an operator is applying BPM comprehensively, across all plants and processes that involve the handling of radioactive substances. To do so, Agency staff may inspect the operator's overall schedule or programme for undertaking BPM studies to confirm that it covers all necessary aspects and that progress in completing these studies meets any deadlines specified in the authorisation. When examining the operator's programme, Agency staff should ensure that account is taken of expected

changes on the site (plant closures, new operations etc.) and information is updated regularly to take account of technological and other developments. Agency staff should also ensure that the programme and the BPM studies that are undertaken are sensibly prioritised in terms of the plant, operations and/or radionuclides considered.

To assess priorities on a large and complex site, the operator should have considered the contributions made by each of the relevant plants, operations and radionuclides to critical group doses from the site, collective dose, and overall activity discharged (to air or water) and/or activity disposed as solid waste, as appropriate. Other relevant factors could be the persistence of a radionuclide in the local environment (which depends on half-life and concentration factors in environmental materials) and its radiotoxicity. Site specific numerical criteria may be devised for setting priorities or more qualitative arguments may be used.

Agency staff may wish to spend time determining an operator's ongoing commitment to implementing BPM prior to their regular review of the operator's site authorisation, to feed into the authorisation review process. Amendments to RSA'93 included in the Energy Act 2004 require the Agencies to carry out periodic reviews of the limitations and conditions attached to each authorisation they grant, and allow the Agencies to carry out additional reviews as they think fit. Further amendments to RSA'93 included in the Energy Act 2004 allow both the Agencies and site operators to apply for variations to existing authorisations.

When regulating a large and complex site, Agency staff should ensure that the operator has developed and is implementing a prioritised programme of BPM assessments which extends over a period of one or two years but which is flexible to take account of changing circumstances. It would be sensible for Agency staff to agree this programme in advance with the operator. This issue was discussed in the consultation and received widespread support.

Agency staff should give consideration to requiring the operator to perform a site-wide BPM (or site-wide BPEO) study, in which all contributions to site discharges and doses are considered at a more strategic or scoping level than the detailed BPM studies for specific plant and operations. The site-wide study will also enable interactions between various plants and operations to be examined.

4.3 Assessing an operator's BPM study and documentation

At times, Agency staff may need to assess an operator's specific BPM study and associated documentation. This may be as a representative sample of the operator's overall BPM implementation programme or it may be because Agency staff have requested that a specific BPM study be done and submitted to them for a proposed new plant or process. In either case, the most important aspects of the BPM study that Agency staff would wish to scrutinise that the operator has:

- appropriately specified the scope and context;
- considered a wide enough range of options;
- evaluated an adequate range of environmental impacts;
- compared options appropriately on the basis of their environmental impacts;

- evaluated costs appropriately;
- applied proportionality in a logical and transparent manner, and arrived at a decision that is robust and justifiable.

At all times, the operator's BPM documentation should make clear the methodology that was followed for the study, and work at each stage in the study should be clearly set out, transparent and verifiable.

The content and complexity of the BPM documentation should be proportionate to the issue at hand and any hazard posed to people and the environment. In some cases (e.g. BPM study for certain existing plants and processes with limited current environmental impacts) all that may be required is a short report comparing the advantages and disadvantages of any alternative technologies and/or management practices compared to those in use, together with a defensible argument for any improvements that have or have not been implemented following the study.

For more complicated new plant or processes (or existing operations with associated large environmental impacts), then a more comprehensive suite of documentation may be appropriate that includes a detailed review of alternative technologies and a multi-attribute analysis of their potential environmental impacts.

The key factor that Agency staff have to examine is not whether the BPM documentation contains sufficient complexity but whether or not robust and transparent arguments are presented by the operator to justify their planned approach to optimise control over the management of their radioactive substances.

4.3.1 Purpose, scope and context of the operator's BPM study

Agency staff should satisfy themselves that the operator has appropriately defined the purpose, scope and context of the BPM study so that it achieves its intended aim. Factors to be considered when evaluating the scope and context of a BPM study may include:

- a clear statement of the purpose, scope and objectives of the BPM study and whether it is for a particular plant or process or is more generic;
- underlying uncertainties and assumptions in the information provided;
- the wider context in which the decision is being made to clarify what is within and what is outside the scope of the study, how the scope of the study is bounded and how it relates to other studies (e.g. a previous BPEO study);
- the constraints (e.g. resources, regulations etc.) applied to the study to ensure that the effort is proportionate to the issue at hand.

Agency staff should look for a clear statement of purpose and for an explanation of how this is translated into the scope of the study in terms of the plant, process or radionuclides to be assessed. Any assumptions that constrain the scope of the study should be identified. It is important that the scope of a BPM study is

matched to its purpose. The scope needs to be bounded but should be sufficiently wide to include those issues that are important with regards to minimising discharges from the plant or process in question, and help to discriminate between options.

As part of defining the objectives of a BPM study, it is reasonable to expect consideration to be given to the methodology that is to be used. The operator is free to adopt whatever methodology they choose but Agency staff should ensure that, as a minimum, it adequately addresses the issues covered later in this Section.

4.3.2 The range of options considered in the operator's BPM study

Agency staff have to be satisfied that the operator has considered a sufficiently wide range of options in a BPM study which could improve the aspect being considered (e.g. alternative technologies and methods of operation to reduce the level of radioactivity discharged). As discussed in Section 4.1.1, Agency staff should be aware that the range of options available on a non-nuclear site may be very different to those on a nuclear licensed site, and so may be the benefits and detriments of those options.

For existing plants and operations on all sites, the operator need only be required to consider options for reducing waste generation and discharges. The operator should then compare these with the present plant and operating methods so as to find out whether change is warranted.

For proposed new plants and new operations at existing sites (including decommissioning activities), the operator should include options involving a range of different waste arisings and discharges, so that it is evident that the best available option is chosen from all alternatives. The range considered by an operator should encompass options for limiting overall quantities of wastes, as well as options for limiting discharges, and can include alternatives for management procedures as well as technical aspects. It should take into account the waste hierarchy, in which the first preference is to avoid creating wastes, the second to minimise the amounts created, the third to re-use waste or some of its constituents, the fourth to recycle wastes and the last to dispose (or store). There should also be options for varying degrees of precautionary action. Where appropriate, the range should reflect a preference for 'concentrate and contain' over 'dilute and disperse'.

For more complex new plant or processes, where a staged BPM study may be appropriate (see Section 4.2.1), Agency staff may wish to discuss with the operator the range of options being considered.

When the number of options potentially needing to be compared is large, the operator may have screened out some options. In this case, Agency staff should decide whether the screening criteria used are appropriate. Cost can be used as a screening criterion provided this is done in accordance with the principle of 'gross disproportion'. In some cases this will be a matter of 'common sense'. For example, Agency staff may agree if a hospital argued that it would not be sensible to spend millions of pounds on reducing its discharges by a small proportion, provided discharges are already low.

If an operator uses financial considerations as screening criteria, Agency staff should be aware that affordability in terms of the monetary requirements is not a legitimate factor to use in a BPM study, though the costs themselves are, provided the gross disproportion principle is applied.

4.3.3 The operator's evaluation of impact

Agency staff need to ensure that an operator considers a sufficiently wide range of impacts so that the different options can be sensibly compared. The number and range of impacts considered should be consistent with the issue at hand and whether or not BPM are being considered for existing plant and operations, or for new plant and associated new discharges.

For existing plants and operations on any site, it would be appropriate for the BPM study to focus on the impacts that arise due to the current practice and to quantify any potential reductions in these impacts that may be afforded by alternative practices.

In the case of proposed new plants and processes on a nuclear licensed site, a wider range of impacts would need to be considered that relate to the four general types of radiological impact (Table 1):

- impact of routine radioactive discharges and disposals on the public and the environment,
- impact of potential accidents on the public and the environment,
- occupational doses, and
- solid radioactive waste arisings.

The impacts given in Table 1 are examples and the list is not intended to be comprehensive or exclusive. When assessing a BPM study for proposed new plant or processes on a nuclear licensed site, Agency staff should be satisfied that at least one specific impact of each of the four general types has been included, where relevant, and that all impacts have been quantified appropriately. In each case the impact to be considered is that throughout the operating life of the option and during its decommissioning. This 'cradle to grave' approach is essential to avoid introducing measures that would have short-term benefits but would cause long-term problems.

In the case of proposed new plants and processes on a non-nuclear site where the amounts of activity used and discharged are small, it may be appropriate for the operator to consider a subset of the impacts from Table 1. At a minimum, a non-nuclear site should quantify the amount of proposed discharges and disposals, and the resulting impact to the critical group, and the volume and activity of solid waste arisings. Agency staff may wish those non-nuclear sites with larger holdings of radioactive material, and those undertaking more practices, to consider more of the impacts in Table 1. In all cases, Agency staff should ensure that the operator has identified those radiological impacts that may be particular for the issue at hand.

Table 1: Types of radiological impact that could be relevant in a BPM study for proposed new plant or processes on a nuclear licensed site.

General Type of Impact	Example Specific Type of Impact
Impact of radioactive discharges and disposals on the public and the environment	<ul style="list-style-type: none"> ▪ peak annual critical group dose ▪ public collective dose to the European Union or world population over 500 years ▪ peak concentrations of key radionuclides in environmental indicator materials (e.g. lichens, seaweeds, seabed sediments, grass)
Impact of potential radiological accidents on the public and environment	<ul style="list-style-type: none"> ▪ risk to individuals
Occupational doses	<ul style="list-style-type: none"> ▪ peak annual individual worker dose ▪ collective worker dose
Solid radioactive waste arisings	<ul style="list-style-type: none"> ▪ volume and activity of VLLW generated ▪ volume and activity of LLW generated ▪ volume and activity of ILW generated ▪ volume and activity of HLW generated

Non-radiological impacts should also be quantified by an operator if they are likely to be significant and different for the various options, and may impact on the chosen option. Examples of the types of non-radiological impact that may be considered in a BPM study are shown in Table 2. Note that while radiological impacts must always be considered in a BPM study, non-radiological impacts need not necessarily be considered in every case. There is, however, a fundamental requirement that the site operator should always ensure that in implementing BPM to manage its radioactive wastes, the operations do not compromise any other statutory or legal requirements.

Table 2: Types of non-radiological impact that could be relevant in a BPM study for new plant or processes.

General Type of Impact	Specific Type of Impact
Emissions	<ul style="list-style-type: none"> ▪ long-term air concentrations ▪ long-term soil concentrations ▪ long-term water concentrations
Noise	<ul style="list-style-type: none"> ▪ noise levels at each sensitive location
Potential accidents	<ul style="list-style-type: none"> ▪ risk score
Visual impact	<ul style="list-style-type: none"> ▪ visual impact score
Odour	<ul style="list-style-type: none"> ▪ air concentrations
Global warming potential	<ul style="list-style-type: none"> ▪ global warming potential
Ozone creation potential	<ul style="list-style-type: none"> ▪ photochemical ozone creation potential
Disposal of solid wastes	<ul style="list-style-type: none"> ▪ amounts of inert, non-hazardous and hazardous waste generated ▪ level of disposal routes within the waste hierarchy

Agency staff should satisfy themselves that the operator has included the appropriate radiological and non-radiological impacts and has quantified them in

appropriate ways. When considering non-radiological impacts, Agency staff may draw on the list of matters from Schedule 2 of the PPC Regulations (2000) that require consideration in the determination of BAT.

An operator should be given the flexibility to use the approach they consider to be most appropriate for quantifying these environmental impacts. Agency staff may, however, wish to agree the approach to quantifying impacts with the operator in advance.

4.3.4 The operator's comparison of options on the basis of environmental impact

Agency staff should ensure that in any BPM study the operator compares options on the basis of their environmental impacts before examining the relative costs of options.

The method chosen for comparing options on the basis of their environmental impacts will vary depending on the complexity of the study, and the issue at hand. For relatively simple BPM studies for existing plant and processes, all that may be required is to rank the options in order of their respective generated waste volume and/or activity discharged, depending on which of these impacts is capable of being minimised by application of new or improved techniques.

Very high cost options which are highly unlikely in practice to be judged to be BPM only require simple evaluation.

For BPM studies for complex new plant or processes, then a more detailed approach is likely to be required. In such cases, a suitable method of comparing options on the basis of their environmental impacts is to rank the options on each general type of radiological impact separately, then to rank them on all types of radiological impacts together. This can also be done for non-radiological impact, and the options are then ranked on the basis of radiological and non-radiological impacts together.

In some cases, judgement will need to be made about the relative significance of different environmental effects, sometimes in different media. In comparing these, certain basic parameters may help to reach a conclusion. For example, the Agencies view long-term, irreversible effects as being worse than short-term reversible ones, if all other factors such as immediate severity are equal. These comparisons will often be an inexact science and, therefore, if the study looks to rank options, Agency staff should take note of the following:

- all assumptions, calculations and conclusions must be open to examination;
- generally, using simple numerical analyses to compare or aggregate different types of environmental effects should be avoided, except where there are recognised ways of doing this. Individual effects within options should be assessed quantitatively where possible. However, the overall study and comparison of options should normally include significant qualitative elements; and
- expert judgement should be used alongside the particular constraints of the appraisal system, so that common sense conclusions are reached.

In some cases the method used in the BPM study will result in a clear ranking of options on the basis of their environmental impacts, but in other cases there will be little or no distinction between two or more options. Whatever the result, the information will be useful in assessing whether BPM is being or will be applied to manage radioactive wastes.

As part of a BPM study, an operator should identify any key uncertainties and, if these may affect the outcome and final identification of the BPM, Agency staff should ensure that the operator has undertaken a sensitivity analysis to test how environmental impact may be affected by the uncertainty.

4.3.5 The operator's evaluation of costs

The 'cradle to grave' approach adopted for environmental impacts (see Section 4.3.3) also applies to the financial costs of options. With this approach the total gross cost of an option is the sum of its plant construction cost, or equipment manufacture and fitting cost, its lifetime operating costs and its decommissioning costs, including the disposal or long-term storage of radioactive and other wastes. The quantities of interest for assessing the BPM are the net costs of options. These are obtained by subtracting from the gross costs any profit or productivity increases or cost savings that the operator would make if the options were implemented. Cost savings could include, for example, those arising from using smaller quantities of raw materials or efficiency savings in terms of material or human resources.

Agency staff are advised to consider primarily the total net undiscounted costs of options when assessing the BPM study. This is because use of a high discounting value can mask differences in the long-term costs of options. The site operator may have estimated discounted costs as well, or any other cost quantities that the organisation usually uses in investment decisions, but these need not be considered by Agency staff. Similarly Agency staff need not consider any affordability arguments put forward by an operator.

4.3.6 Assessing the operator's application of proportionality and decision

An operator's BPM study needs to present in a transparent way the various options which could improve the aspect being considered (e.g. reduce the level of radioactivity discharged). The operator should propose implementing the option or combination of options that achieves the greatest improvement, provided it is reasonably practicable. It is not sufficient for the operator to consider the cheapest option first and consider the more expensive options only for the marginal improvement they would give. Possibilities may include partial implementation of an option and implementation of more than one option. The presentation and discussion of discarded options is a valuable part of a BPM study.

The most significant part of an assessment by Agency staff of the operator's BPM study is the examination of the proportionality arguments. Since there are no fixed criteria or calculations by which to measure proportionality, Agency staff must use judgement in assessing whether or not any additional expenditure by operators (i.e. to commission new plant or implement new procedures to minimise discharges) would be 'grossly disproportionate' to the resulting benefits. Two approaches may help Agency staff make this judgement. The simplest is to compare what is proposed by the operator with what has recently been done, and

accepted by the Agencies, at similar facilities elsewhere, since this is an important source of assessing what is currently to be regarded as 'best practicable'. A more detailed approach that takes account of local circumstances would be to rank all of the options available to the operator in order of increasing environmental benefit. How this is done would depend on the issue at hand but, in most cases, a useful approximation would be simply to base environmental benefit on the total activity discharged or solid waste created by each option. Other parameters may be important in certain circumstances, e.g. where large amounts of resources may be used to implement certain options or where non-radiological pollutants may pose a greater hazard than radiological pollutants.

Once ranked by environmental benefit, Agency staff should identify the option the operator deems to be BPM and then examine what the additional expenditure and environmental benefit would be if the next better performing option were chosen instead. It is the relative difference in expenditure and environmental benefit between the suggested option and the better performing option that will indicate, in most cases, which of the two options is the BPM using the test of 'gross disproportion'. One way of demonstrating that the gross disproportion test is adhered to is to undertake a Cost Benefit Analysis.

When considering the above, Agency staff should bear in mind that responsibility for demonstrating that BPM are being used on a particular site lies with the operator. It should be the expectation of Agency staff that the operator (applicant) would do most of the work to demonstrate that BPM are being or will be used. The operator should be encouraged to present their BPM study using the approach above or a similar transparent format, so that Agency staff can have confidence in the operator's approach, and do not need to expend time in replicating the operator's efforts.

A BPM study may indicate that there are various available options, each with differing levels of environmental impacts for differing costs. In such cases, the choice which option represents BPM may not be obvious, and the following logic can be used to determine which option is BPM (the logic is also shown graphically in Figure 4). The logic is based on using discharges and disposals or radioactive waste as a surrogate for environmental impact, and cost as a surrogate for money, time and trouble.

- A. If the least expensive option has the lowest impact then this represents the BPM.
- B. If several options result in similar impacts but with very different costs, then the least expensive option represents the BPM.
- C. If there are several options with similar impacts and similar costs, then any one could represent the BPM. In such a case, the decision between options may be based on factors other than those included in the BPM study (e.g. ease of implementation or track record of particular plant designs).
- D. If the options fall into two groups where in one costs rise slowly from one option to another and environmental impacts fall rapidly, and in the other costs rise rapidly and impacts fall slowly, then the BPM is likely to be the most expensive option in the first group, because the second group of options represent a regime of diminishing returns.

- E. If the ranking of options on cost is the reverse of the ranking on environmental impacts, there are large differences between the costs and impacts of the options, and there is no obvious point of diminishing returns, then the decision between options may be based on placing more emphasis on discharge reduction and precautionary action than on cost benefit analyses for dose reductions.

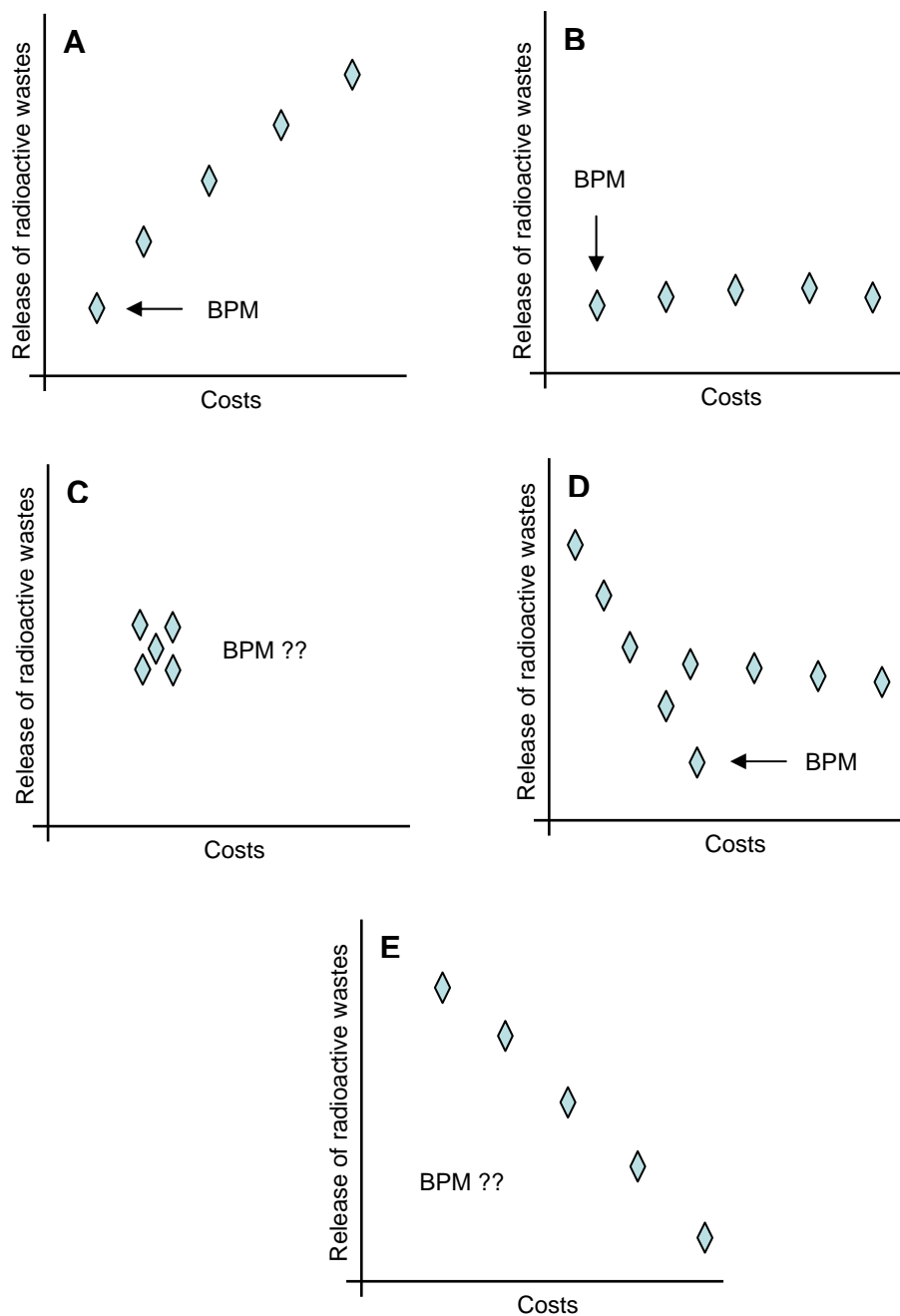


Figure 4: Choosing the BPM from proportionality considerations, when differing levels of environmental impacts for differing costs are revealed in a BPM study. See text above.

In addition to examining the operator's proportionality arguments, Agency staff should also satisfy themselves that the operator has applied the following factors when they assess what represents BPM for their plant and processes:

- BPM can only be applied to those aspects of radioactive waste management that the site operator controls.
- Affordability in terms of the monetary requirements required by the operator to implement the BPM option is not a legitimate factor to use in a BPM study, though the costs themselves are.
- BPM should not be invoked to argue against meeting relevant legal requirements, declared Government policy or international treaty obligations.
- There should be a clear demonstration and reasoning behind the methods applied to balance and trade-off all detriments and risks.
- It is important how the site operator uses and interprets the term 'best practicable'.
- It is reasonable that arguments about the timescale for implementation may be a factor in the choice of options. Less effective options that can be implemented quickly may be BPM compared to more effective options that will take many years to develop. This is particularly the case for facilities or sites that may have only a limited remaining operating life.
- If the BPM employs a comparison of costs and benefits to rule out an improvement, it must be shown that the costs of the improvement would be 'grossly disproportionate'.
- It is important how the site operator understands and addresses societal concerns given that Cm 2919 identifies social factors as being relevant to the definition of BPM.

4.3.7 Self monitoring and reporting by the operator

Operators will have significant responsibility for self-assessment as a means to demonstrate compliance with the conditions and limitations in their authorisation. As part of any BPM assessment or review, Agency staff should look to assess actual or proposed procedures for undertaking the study, the equipment and techniques used, and the associated management procedures.

4.4 The assessment

Agency staff should, on a case-by-case basis, satisfy themselves that the outcomes of the operator's BPM study represent the BPM for the particular circumstances. In making this assessment, Agency staff should take into account the information resulting from the operator's BPM study, including arguments that particular alternatives are or are not the BPM, along with information from other sources.

In making their assessment, Agency staff may need to consider a range of factors. Although not exhaustive, on a case-by-case basis, Agency staff may wish

to adapt the following list of issues on which they would focus attention when assessing any BPM study:

- How the creation of waste is prevented or minimised.
- How the unnecessary introduction of waste into the environment is avoided.
- How the presumption for “concentrate and contain” is applied in practice.
- How the segregation and categorisation of wastes is undertaken and dilution avoided where practicable.
- How it is ensured that radioactive wastes are safely disposed of, at appropriate times and in appropriate ways.
- What steps, if any, operators have implemented to achieve progressive reductions in discharge limits and discharges.
- How close the operator is to the authorised discharge or disposal limits in its authorisation.
- What headroom is there between reported discharge or disposal limits and those authorised by the Agencies.
- Whether the operator requires an increase in discharge or disposal limits and are these exceptional cases.
- When and how BPM studies or reviews are undertaken.
- How monitoring of operational plant/processes, radioactive waste and the environment is undertaken.
- How the technologies processes and operations in use compare with UK and international best practice.
- What measures operators use in the design and operational management of their facilities to minimise discharges and disposals of radioactive waste.

Agency staff should be explicit about which factors they have considered and how they have been taken into account.

As part of their assessment, Agency staff should be aware that BPM must be implemented within the context of wider environmental legislation (including both radioactive and non-radioactive laws and regulations) and this may constrain what is deemed to be BPM.

In all cases it is important that Agency staff ensure that their judgement and the reasons for it are recorded and documented properly. In the case of nuclear licensed sites, Agency staff may wish to publish the basis for their decision on a revised authorisation (e.g. EA [2001]). In particular there should be clarity about how less quantifiable factors are taken into account when assessing BPM (see, for example, DTI [2002]). Where Agency staff need to or wish to consult on assessments associated with applications or other considerations of revised authorisations, the consultation could ultimately lead to a revision of the operator’s BPM study or the identification of a different option as the BPM.

Occasionally in complex or high profile cases where Ministers are consulted, they may direct Agency staff to take an alternative view of the BPM to be adopted. In such cases, the reason for Ministerial direction should be made explicit by Agency staff in the record of the decision.

Once Agency staff have completed their assessment of the operator's BPM study, they can make a judgement as to whether or not to accept the option that the operator has proposed to be BPM. If they do not, the reasoning should be explained to the operator and set out what improvements they expect the operator to implement and the timetable for doing so, so that BPM are used.

Where a BPM study has been undertaken by an operator as part of their own management procedures, there is no need for this to be submitted to or assessed by Agency staff, unless Agency staff choose to examine this as part of their routine inspections.

4.5 Providing general advice to the operator

4.5.1 Advice on BPM methodology

It is not appropriate for Agency staff to specify the methodology to be used by an operator when they undertake a BPM study. If asked for advice, it is suggested that they refer operators to the considerations given in the Horizontal Guidance Note IPPC H1 [EA et al., 2001] as a useful source of background information on which to base their approach. This methodology is developed for BAT studies but, due to the similarities in approach to limiting discharges and environmental protection, has considerable relevance to BPM.

Agency staff should encourage operators to perform thorough BPM studies, albeit without expending excessive effort (i.e. to adopt a proportionate approach).

4.5.2 Public record

It should be made clear to the operator that the results of any BPM study submitted formally to the Agencies may be made public (the Agencies are bound by the Freedom of Access to Information Regulations). In certain cases, the full BPM study may be published or made available to anyone who requests a copy. There will be instances where it is not possible to do this, for example if the study contains sensitive or financial information which should not be disclosed for reasons of national security or protection of business interests.

Operators are free to do their own BPM study, as part of their environmental management and other procedures, and these studies need not be submitted to the Agencies or be published.

4.5.3 Other benefits

BPM is being given increasing emphasis in radioactive waste management policy because of its potential benefits to society as a whole. Whilst this is important, there are other benefits to the operator from undertaking BPM studies that Agency staff may wish to emphasise to operators which could reduce the regulatory effort involved in enforcing RSA'93, and encourage operators to raise the quality of BPM studies making them easier to assess.

These benefits could include:

- cost savings (e.g. from more efficient use of radioactive materials, from recycling or re-use of materials);
- less effort spent dealing with the Agencies;
- less risk of environmental incidents;
- better quality assurance (QA) of working procedures;
- less effort spent dealing with other stakeholders (e.g. shareholders, environmental groups);
- potential for reduced insurance premiums; and
- increased business as a result of a 'greener' image.

4.5.4 Failure to comply with BPM

Should Agency staff conclude that BPM has not been or is not being used by an operator it will be open to them to refer the matter to the appropriate authority with a view to bringing a prosecution against the operator for failing to observe a condition of the authorisation. Should such a matter reach the courts it would be for the court to decide what constituted BPM for any given process at a particular time and whether it was in fact being observed.

5 OUTSTANDING ISSUES

A number of issues arose during this project, particularly from the consultation, that require further analysis before a formal guidance manual can be issued to Agencies. These are briefly described below.

5.1.1 Harmonisation of regulations

A culture of environmental protection would also be better supported by harmonisation of the requirements of radiological (RSA) and non-radiological (PPC) regulations. If it were clear that similar levels of effort were put into implementing BPM as are put into BAT, for similar degrees of environmental hazard, then BPM (and BPEO) and BAT studies could be brought into line. If similar study methodologies for BPM and BAT were also adopted then further transparency and potential cost savings could result.

To some extent, this issue is addressed by the new requirement for nuclear licensed sites to produce an IWS that will address the management of both radioactive and non-radioactive wastes, since it overlaps RSA'93 and EPA'90 considerations.

5.1.2 Health and safety of workers

The safety aspects of keeping and using radioactive materials are subject to regulation by the HSE. Nonetheless, radiation protection of workers and accident risk are issues that an operator should consider in their BPM studies, although the focus of the Agencies' interests are on radioactive waste management.

Several participants in the operators' workshops, from both nuclear licensed and non-nuclear sites, expressed concern that if BPM favours concentrate and contain over dilute and disperse, minimising discharges could lead to a transfer of risk from the public to workers.

A particular area where risk transfer is an issue is where additional processes need to be carried out on the site to reduce the quantity of radioactive waste discharged to the environment. This usually results from actions taken to reduce discharges to comply with BPM. A possible consequence of this is that on site accumulation of radioactive waste will increase unless a disposal route exists. There is therefore a 'transfer' of risks from off-site risks from discharges to risk both on and off the site under fault conditions and additional operator doses. Thus, more information is needed to assess how weightings can be applied to optimise the risks transferred, including those arising from additional operator doses.

It is important that any future guidance is explicit on the objectives and scope of BPM and how BPM as applied to radioactive waste management and, particularly, the BPM/ALARA link relates to the HSE(NII) use of ALARP. Specifically, more information is needed to assess the balance and trade-offs between safety and environmental risks.

There was agreement from all parties that any future guidance document should indicate what the Agencies expect to see in a BPM assessment about the transfer of risk, and the health and safety of workers. Such issues are best resolved by using the mechanisms established under separate Memoranda of Understanding

between each of the environment agencies and HSE(NII). Reference should also be made to the joint HSE and Environment Agency report called 'Working Together' [HSE and EA, 2003].

5.1.3 Generic studies

The term 'generic BPM study' is used here to mean a BPM study undertaken by a group of operators on a topic relevant to them all.

There was widespread support from consultees for generic studies, particularly amongst some non-nuclear site operators that face similar waste management issues (e.g. hospitals and iodine delay tanks).

Such generic studies could then be used as a baseline for site specific BPM studies that reflect individual operators' circumstances. The benefits to operators of carrying out generic BPM studies arise from the reductions in effort required for their site specific studies. When carrying out the latter an operator could refer to the results of the generic study and make any additional site specific points, rather than starting from scratch. This could be particularly attractive to users of radioactive substances at non-nuclear sites. For example, it would be much more efficient if a generic BPM study that dealt with topics relevant to a group of similar hospitals were carried out than for each such hospital to do its own study. It would also be easier to keep a single generic study up to date rather than update many site specific studies.

The use of generic studies would also benefit the Agencies in that a generic study could be assessed once and used by Agency staff to underpin site specific studies. This would provide benefit in terms of efficiency and consistency. Even in cases where it is not possible to do a complete generic BPM study (for example, because the financial costs of options are particularly site specific) a partial study could still be useful. It could include a wide ranging technology review, and identify the advantages and disadvantages of different options, and the circumstances under which they may or may not represent the BPM.

Under RSA'93, the Agencies have powers which allow them to grant an authorisation subject to such limitations or conditions as they see fit. The exercise of this power allows Agency staff to require individual operators to undertake BPM studies and review them as required. There is no mechanism in the Act by which they can require groups of operators to carry out a joint study but also does not preclude them.

The practical use of generic studies remains uncertain and, as discussed in Section 6, a 'learning network' will be established in the forthcoming month to allow comment on generic studies.

An operator or a group of operators may indicate that they intend to carry out a generic BPM study. In this case, Agency staff should agree in advance that there is sufficient similarity (e.g. in terms of the processes, procedures, site conditions, and potential environmental benefits) amongst the partners to warrant a generic study and that the use of such a study would be appropriate in each particular circumstance. Prior to undertaking a site specific study, the issues and areas of the study that would require additional site-specific considerations to be addressed by each operator individually (e.g. cost issues) should also be agreed between Agency staff and the operator.

6 THE WAY AHEAD

The original scope and objectives of the project were met in part, although the consultation process revealed that there is no clear consensus between the consultees with regard to some of the key aspects of BPM and how these should be addressed in a regulatory framework and guidance manual (e.g. in relation to the balance of the guidance between flexibility and prescriptiveness).

Due to this lack of consensus, it was decided by the SNIFFER Project Board not to progress to the implementation of a formal guidance manual. Instead, general advice to Agency staff is provided in Section 4 of this report. It is intended that this advice will be trialled by Agency staff over a period of about 12 months within the context of a 'learning network' during which:

1. Agency staff will be asked to use the advice as part of their regular review, inspection and monitoring activities; and
2. operators undertaking a BPM study will be invited to refer to the report and feedback their comments.

As part of the learning network, all observations, experiences and comments from Agency staff and operators on the suitability and applicability of the advice will be collated and subsequently used to update and improve the regulatory assessment framework and feed into the guidance manual to be produced at a later date.

This report represents 'work in progress' and as discussed in Section 5, a number of issues arose during this project and its associated consultation that could not be resolved in this report, particular with regards to the harmonisation of environmental regulation, health and safety of workers, and the development and application of generic BPM studies. As part of the learning network, Agency staff and operators are encouraged to identify and comment on these and any other issues that require further analysis before a formal guidance manual could be issued.

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APPENDIX I: ORIGINAL PROJECT AIMS AND TERMS OF REFERENCE

This Appendix presents the original aims and objectives of the project, and includes the project specification and terms of reference which were issued to the contractor.

Project Aims and Objectives

The original project aims and objectives were set to be:

1. to review the policy, legislation and guidance related to BPM so as to define the regulatory context in which BPM policy was intended to apply to radioactive waste management in the UK as set out in Cm 2919 and documents prior to and contemporary with it; the extent to which the original intentions of BPM still apply or have been superseded; and the relationships and distinctions between BPM and other environmental protection concepts;
2. to undertake consultation with Agency staff and operators of nuclear licensed and non-nuclear sites, UK Government departments and agencies, and other relevant parties so as to obtain their views on the fundamental principle of BPM and its position within a regulatory framework aimed at protecting the public and the environment, and to hear first-hand experiences of operators who have undertaken BPM studies and Agency staff who have assessed them; and
3. from the above, to provide advice to Agencies staff about how to assess the key processes used by site operators to underpin the implementation of BPM to manage their radioactive wastes, and to define the necessary features of a regulatory framework for the assessment of operator's BPM studies and to develop a guidance manual for use by Agency staff.

It was the intention that this advice could be used by Agency staff when:

- evaluating site operators' applications for new or revised authorisations under RSA'93 for disposal of radioactive wastes; and
- assessing whether site operators are complying with the BPM conditions and limitations in their existing RSA'93 registrations or authorisations (i.e. are applying BPM on a continuing basis).

Project Specification

The original project specification is set out below.

Background

The Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) on behalf of the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA) and Environment and Heritage Service, Northern Ireland (EHS) is seeking to commission the research described in this specification to develop a regulatory framework to assess the application of Best Practicable Means (BPM) for the management of radioactive wastes.

The EA, SEPA and EHS (the Agencies) are responsible for the protection of the environment in England and Wales, Scotland and Northern Ireland, respectively. One of the key functions of the Agencies is to regulate the disposal of radioactive waste in accordance with an authorisation granted to site operators under Section 13 of RSA'93.

Since the formation of the Agencies, there has been no guidance written as to how BPM is applied to control radioactive waste management. Also, as there is no legal definition of BPM, site inspectors from the Agencies have assessed BPM related information supplied by nuclear site operators on a case by case basis using Government policy which was last updated in 1995³. The Agencies interpretation of Government policy is that, when applied, BPM should ensure that radioactive wastes are managed and disposed of in ways that protect the public, workforce and the environment and are not created unnecessarily.

The 1995 Government policy statement is increasingly being overtaken by developments such as the UK Radioactive Discharge Strategy, draft statutory guidance to the EA, the Managing Radioactive Waste Safely consultation process and the imminent creation of the Liabilities Management Authority. Against these developments, the Agencies consider that there is now a need to develop an assessment framework that takes account of two distinct cases where BPM is used by the Agencies as part of the RSA'93 licensing regime:

- In cases where the site operator applies for an authorisation to dispose of radioactive waste and the Agencies have to determine whether the practice is conducted in a manner that accords with our requirements to ensure public dose is kept as low as reasonably achievable (ALARA), and that waste generation is minimised and, where waste is generated, to ensure steps are taken to minimise both its volume and activity; and
- In cases where the Agencies have to assess whether the site operator continues to apply and use BPM in accordance with the limits and conditions in its licence granted under RSA'93.

Although the project deals mainly with BPM as applied at nuclear licensed sites, consideration should also be given to other sites such as hospitals and universities where radioactive wastes are kept, used, stored or disposed of. These aspects should be addressed in the project methodology.

The project will require regular liaison with field inspectors, regulatory specialists, and economists within the Agencies. The project will also require liaison with other bodies such as the Nuclear Installations Inspectorate, DEFRA, Radioactive Waste Management Advisory Committee (RWMAC), nuclear site operators and small user groups based throughout the UK.

Aims

The main aim of the project is to develop a BPM assessment framework that accords with Government policy, is suitable for use by the Agencies and will help to guide site operators and consultants in understanding the Agencies' views of BPM and the information required to demonstrate regulatory compliance.

³ Review of Radioactive Waste Management Policy, Final Conclusions, Cm 2919.

In meeting this aim, it is expected that the contractor will be required to:

- review the development and application of extant BPM policy and determine the regulatory context under which BPM policy was intended to apply to radioactive waste management in the UK;
- consider all Government legislation and associated guidance published since Cm 2919 which deals with BPM, and determine to what extent the original intentions of BPM still apply or have been superseded;
- examine the apparent conflict between progressive reductions in discharges as referred to in the UK National Discharge Strategy and the application of BPM or Best Available Techniques (BAT);
- review the various inter-relationships and distinctions between BPM, Best Practicable Environmental Option (BPEO) and As Low As Reasonably Achievable (ALARA) and compare and contrast BPM with the concept of BAT as adopted by Integrated Pollution Prevention Control (IPPC) legislation;
- working closely with the Agencies' staff, carry out a review of those conditions and limitations relating to BPM included by the Agencies in licenses granted to nuclear sites under RSA 93 and determine what aims and purposes the conditions and limitations are trying to achieve, and their effectiveness;
- determine the main principles and the scope, type and details of information that should be submitted by site operators to demonstrate compliance with BPM policy and the main principles of other legislation and guidance relating to BPM;
- evaluate and recommend standards, procedures and tests the Agencies could apply as a basis to assess the BPM related information from site operators;
- present the development and findings of the work to nominated staff within the Agencies by means of a facilitated workshop to elicit feedback from SEPA, EHS and EA staff;
- record the development and findings of the project and the workshop in the form of a report; and
- document the BPM assessment framework, with worked examples and proformas where appropriate, in a guidance manual that is in a suitable format for consultation with external stakeholders.

Project Plan

The tasks shown below are included only to provide an indication as to the scope of the work and are based on the project aims defined above. In reviewing tenders, the Agencies will want to see evidence that the tenderer has considered innovative ways and approaches to the proposed assessment framework which implements the Government's requirements of BPM in an open and transparent manner.

Tasks

Task 1. To review the development and application of BPM policy as it has, previously, been formulated in documents such as Cm 2919 and determine the regulatory context under which BPM policy was intended to apply to radioactive waste management in the UK.

Task 2. To consider all Government legislation and associated guidance published since Cm 2919 which deals with BPM, and determine to what extent the original intentions of BPM still apply or have been superseded. Cognisance will have to be taken of emerging legislation such as the UK National Discharge Strategy, the Nuclear Reform White Paper and associated guidance to the Agencies. Key issues within the discharge strategy such as the requirement to ensure progressive reductions in liquid and gaseous discharges to the marine environment and the 'concentrate and contain' and 'precautionary' principles will need to be evaluated. A particular issue of interest to the Agencies is the apparent conflict between progressive reductions in discharges as referred to in the UK National Discharge Strategy and the application of BPM or BAT.

Task 3. To review the various inter-relationships and distinctions between BPM, BPEO and ALARA principles used for radioactive waste management and assess whether BPM is similar, or otherwise, to the concept of BAT as adopted by IPPC legislation with, particular emphasis on the Agencies requirements stated in Cm 2919 to ensure proportionality.

Task 4. To analyse and critically review a selection of BPM studies that have been submitted by site operators to the Agencies, or are in preparation, either in support of applications for an authorisation or as a review required by the conditions and limitations in their authorisation. The contractor will need to determine the confidentiality status of the documentation which is received. Some discussion with site operators and authors of submissions may be required to determine how they use and apply BPM to realise an optimisation approach to radioactive waste management.

Task 5. Using the outcomes from Tasks 1-4, determine the main principles and the scope, type and details of the information that should be submitted by site operators to demonstrate compliance with BPM policy.

Task 6. To evaluate and recommend standards, procedures and tests (together referred to as proformas), which together form a framework, that the Agencies could apply as a basis to assess BPM related information. This assessment framework should accord with the Agencies' regulatory powers granted under RSA 93. A key issue is that this assessment framework should be capable of being applied consistently and in an open and transparent manner. Judgements, reasons and assumptions about the choice of the assessment framework should be fully documented.

Task 7. On completion of Task 6, to issue a report presenting the findings and conclusions to date.

Task 8. In conjunction with SNIFFER and the Agencies, to facilitate a workshop for field inspectors and functional specialists at a venue to be agreed with the Project Manager. The workshop should present the development and outcomes of the work to date but should include sufficient technical background and

information to allow those attending the workshop to focus on finalising the scope and aims of the BPM assessment framework. Feedback from the workshop is to be used in finalising the manual to be developed in Task 10.

Task 9. To record the development and findings of the project and the workshop in the form of a technical report. The report is to be submitted to the Project Board in draft for comment. All comments are to be incorporated and agreed with the Project Manager before the final report is issued.

Task 10. To document the BPM assessment framework in the form of a guidance manual with worked examples to aid understanding. This manual should be written in the form of guidance that is suitable for use by the Agencies, site operators and consultants. Details of the assessment framework must be explained in full using worked examples to support the manual. Relevant proformas, where appropriate, should be included as an appendix to the manual. The manual should be in a format that is suitable for consultation with external stakeholders.

Deliverables

The deliverables for this project will be:

1. On completion of Task 6, to compile an interim report to be agreed with the Project Board, which details the findings and conclusions of Tasks 1-6 inclusive.
2. On completion of Task 7, to prepare supporting material about the BPM assessment framework for presentation and discussion at a facilitated workshop. The outcomes and findings of the workshop are to be incorporated in the final technical report and guidance manual.
3. On completion of Task 9, to report on all findings, conclusions and recommendations to date (technical report).
4. On completion of Task 10, to prepare a guidance manual, which includes worked examples and proformas where appropriate, describing the BPM assessment framework, and is presented in a format suitable for external consultation. The technical report and manual will be published by SNIFFER, on behalf of the EA, SEPA and EHS. The detailed structure, content and format of these documents will be subject to discussion and agreement with the Project Board. The Project Board will require six hard copies of the draft documents, and one copy of the final documents in paper and electronic (Microsoft WORD and pdf format).

APPENDIX II: THE CONSULTATION PROCESS

This project was informed by a consultation process that involved eliciting information and views from Agency staff and operators of nuclear licensed and non-nuclear sites, UK Government departments and agencies, and other relevant parties on the fundamental principle of BPM and its position within a regulatory framework aimed at protecting the public and the environment, and first-hand experiences of operators who have undertaken BPM studies and Agency staff who have assessed them. The consultation process involved the distribution of questionnaires to interested parties and a series of workshops.

Questionnaires

The consultation process began with the drafting of a questionnaire that was circulated widely to operators of nuclear licensed and non-nuclear sites, including those who have experience of BPM for new plant, existing plant and decommissioning activities. A similar questionnaire was also sent to Agency staff, the HSE(NII), Defra, Scottish Executive, Welsh Assembly, the Radioactive Waste Management Advisory Committee (RWMAC) and the Liabilities Management Unit (LMU)⁴ within DTI.

These questionnaires invited respondents to comment on their understanding and opinions of the current regulations related to BPM, their recent experiences of undertaking or assessing BPM studies and their suggestions for possible future developments. The questions from these two questionnaires are provided in Appendix III.

A total of 21 responses were received (8 to the Agencies' questionnaire and 13 to the operators' questionnaire). Not all respondents answered all of the questions (often because some considered that a number of questions were not relevant to their own circumstances), and some respondents preferred to frame their responses in report form, rather than use the structure of the questionnaire.

Workshops

Workshop organisation

Two initial workshops (one for operators and a second for Agency staff) were then held to debate specific issues that the questionnaire responses highlighted as being of most interest or concern, or where disagreement was greatest. The same format and approach was adopted for both workshops. At these workshops, after introductory presentations on the BPM guidance development project, participants worked in syndicate groups to discuss one of four specific themes, with the intention of deriving between them a consensus view. These themes were:

1. The definition and objective of BPM, and its relationship to other regulatory requirements and principles.
2. The scope of BPM, and appropriate procedures and methodologies for undertaking one.
3. Operator-regulator interactions throughout the BPM process.

⁴ Now known as the NDA Team.

4. Proportionality issues and how these may be addressed in the BPM process.

The syndicate group participants were encouraged to address and discuss key issues related to these themes on the basis of their own personal and corporate experiences. Each syndicate group was then asked to compile a set of statements which summarised their conclusions, highlighted the extent of agreement and disagreement within the group, and outlined their views on what should be the structure and content of the proposal guidance document.

These statements were then collated and all workshop participants were asked to express their opinion of each statement. In particular, they were asked to indicate whether they agreed or disagreed with each statement, and whether the statement was of high or low significance in terms of whether it needs to be incorporated in the guidance document.

Two further workshops were subsequently held specifically for representatives of non-nuclear sites to ensure their views were properly fed into the consultation programme.

Note that the workshops were convened at a time when it was the aim of the project to produce guidance to Agency staff. As discussed in Section 1 the Project Board decided against producing guidance and revised the project output to be advice to Agency staff.

There was a great deal of lively debate at each of the workshops, both in syndicate groups and in plenary session. No formal records of the workshops were made, although the statements made by the syndicate groups were documented. The following sections provide a summary of each of these workshops: these are not intended to be a 'linear' record of the discussions but rather a distillation of the main points raised during debate and those open questions and other unresolved issues which were identified in the course of the discussion. Comments from participants are not attributed in these reports.

Discussions at the site operators' workshop

This workshop was attended by 17 people, representing operators from nuclear licensed sites (both sites that are operational and sites that are moving towards decommissioning) and non-nuclear sites, including universities, hospitals and manufacturers. This diversity of background was reflected in the discussions during the meeting, and the divergence of opinion on certain issues.

Key points discussed were as follows.

All participants agreed that the guidance document should provide a clear, unambiguous definition of the term 'BPM' and should also define the scope of what is or is not included in the remit of the Agencies with regards to BPM. Several participants expressed concern that 'scope creep' would mean that the Agencies could use the BPM condition in their authorisations to engage in areas that would normally be considered to be within the remit of the HSE(NII).

Although everyone asked for more complete guidance, there was some disagreement as to whether the guidance should be prescriptive or allow for flexibility on the part of the operator. Operators from non-nuclear sites were generally more in favour of defined approaches to BPM than the licensed site

operators. Most participants from nuclear licensed sites felt that a single flexible guidance document should be produced for all circumstances, given that all operators are subject to RSA'93 and are assessed against the same environmental protection principles: this would cover licensed and non-licensed sites, and operational and decommissioning sites. Most participants considered something similar to the H1 (Horizontal Guidance) process outline should be used to define the minimum process methodology for BPM.

The participants considered that the guidance should clearly define the scale of the BPM study as well as the scope of what is expected to be considered within a study. Similar definitions and scopes need also be provided for the related concept of BPEO. Several participants expressed the view that non-technical issues (including stakeholder issues) should not form part of the BPM process, and ought to be included only in BPEO studies which take the strategic view. If they do need to be included in BPM, however, guidance is needed on how weightings should be applied to radiological and non-radiological aspects.

All participants agreed that BPM involves a process of optimisation, which balances the environment and health detriments of discharges and disposals against the costs (monetary and environmental) of efforts to reduce them. The relationship between BPM and ALARA was understood, although some considered those aspects related to the management of materials to be more closely related to ALARP. Similarly, there was agreement that BPEO and BPM overlap but BPM tends to concentrate on a particular discharge or disposal route, whereas BPEO is more concerned with choosing between discrete options.

All believed that BPM could only be implemented in a cost-benefit framework if the concept of proportionality was well defined. It was accepted that the concept of proportionality also extends to the cost of producing the argument. Some participants considered that the proportionality concept meant that what represented BPM in one circumstance need not represent BPM in all cases, because the cost of implementation may vary from site to site.

It was generally acknowledged that BPM is a management principle rather than a document, although the importance of reporting the rationale for the adoption of a particular option as the BPM was recognised (in order to gain an authorisation). As a management principle, the need for regular reviews to ensure BPM are continually being applied was also recognised, and such reviews need not happen only when requested by Agency staff. All agreed that if BPM studies or reviews were triggered by internal management procedures, rather than a request from Agency staff, they need not be submitted to the Agencies.

The idea of generic BPM studies was discussed, and it was widely believed that generic technology reviews would be useful, particularly for some non-nuclear sites such as hospitals that need to deal with common issues. It was broadly agreed that, because of the potential for differing costs of implementation, the cost-benefit element of a BPM, generic technology reviews could not be extended to full generic BPM studies.

Generally there was a view that radiological (RSA) and non-radiological (PPC) regulatory requirements on operators should be harmonised.

Guidance was particularly requested on the issue of how to assess what is or is not grossly disproportionate. Some suggestions for numerical thresholds were

suggested (e.g. on a £/manSv scale) but this did not meet with universal agreement. It is noted that neither the Agencies nor the HSE(NII) have defined any formulation for evaluating the size of the gross disproportion factor for a given level of risk. There was some disagreement as to whether commercial drivers (such as profit/loss and affordability) were factors that could be taken into consideration when assessing what is BPM. Some operators of nuclear licensed sites noted that the forthcoming Nuclear Decommissioning Authority (NDA) will require sites to operate in the most cost effective manner which may impact on what is considered to be BPM.

Similarly, clarification was requested to explain the apparent discrepancy between the Cm 2919 statement that '*optimisation is not required when doses are below 20 µSv/yr*' and the application of BPM which has no lower threshold. That said, there was no agreement between the participants as to whether a lower threshold for BPM should be derived in future guidance or policy.

With a view to proportionality, it was widely accepted that it would be useful if some guidance could be given on how to prioritise and rank BPM studies in terms of their relative importance and the effort that need to undertake them. Several suggestions were put forward and discussed (e.g. based on absolute activity concentrations in discharges or relative to current authorised limits) but no agreement on their applicability or value could be reached. It was requested that further thought should be given to this issue when drafting the guidance document.

Guidance was also requested on how to account for the balance between protection of the environment and protection of workers, particularly because most participants considered that minimising discharges would tend to increase the risks to workers on site. It was felt that such issues need to be resolved between the HSE(NII) and the Agencies.

It was also widely agreed that arrangements between Agency staff and the operator need to be made more transparent, and the interactions between the two parties with regard to the requirement on the operator to perform a BPM study and the requirement on Agency staff to assess the study should be better defined. The guidance should encourage the Agencies to define a programme of interactions with the operators on a case by case basis, that includes setting timescales and deadlines for responding to operator BPM submissions. This programme of interactions, including timescales, should be consistent with the scale of the BPM. It was suggested that, in the event of disagreement between the two parties, some formal complaint or arbitration process should be introduced.

Discussions at the Agencies' workshop

This workshop was attended by 14 people, representing 5 regulatory bodies and Government agencies. In addition, 3 representatives from the operators' workshop participated so as to provide additional feedback from their discussions.

Key points discussed were as follows.

All participants agreed that the better guidance for BPM was needed but it should be focussed on the needs of the Agencies, although it was recognised it would also be useful for operators.

The participants agreed that the guidance document should provide a clear, unambiguous definition of the term 'BPM' and that the guidance should also clearly define the scope of what is expected to be considered within a BPM study and what is considered to be outwith the scope of BPM. Some participants suggested a set of minimum issues should be considered in a BPM (e.g. critical group doses, operator doses, discharge quantities, costs and benefits). Although most other participants considered these to be important issues, there was no agreement that a prescriptive minimum list should be defined, allowing Agency staff greater flexibility when defining the scope.

There was no clear agreement as to whether operators of non-nuclear sites should be assessed against the same framework as licensed site operators. Some participants accepted that the same BPM philosophy applies but not necessarily the same detailed guidance, and that methodologies should take account of differing regulatory interfaces for nuclear and non-nuclear sites.

Similarly, there was no agreement as to whether guidance could be applied to operating as well as decommissioning nuclear sites. Again, some participants accepted that the same BPM philosophy applies but not necessarily the same detailed guidance. Some participants suggested that the decommissioning sites need to be considered on a case-by-case.

All agreed that the guidance should help to define the interfaces between Agency staff and the operator, and the role of Agency staff, but this should not be prescriptive. All participants agreed that interactions between Agency staff and operator should begin as early as possible in the processes, should continue throughout the life of the project and should be planned ahead so far as is possible. There was some disagreement as to whether interactions should be led by the Agencies or operators.

All participants noted that interfaces and responsibilities between different regulators (e.g. HSE(NII) and Agencies) need to be clarified in the guidance document in terms of a number of issues such as the safety in storage v. impacts of discharge, worker safety v. public safety etc.

There was agreement from most participants that the purpose of including BPM requirements in authorisations is to ensure the operator is doing their best to avoid harm to the environment (essentially the EPA'90 definition). Some participants suggested that it is best not to separate BPEO, BPM, ALARA and ALARP because all of these concepts related to optimisation.

Most participants agreed that BPM is about management and methods of operation that are within the control of the operator, and are the means whereby an operator meets ALARA which is outwith his control. It was noted by some participants, however, that circumstances outside of the control of operator may change what is BPM and that the operator needs to take account of these off site issues in developing arguments about what is BPM and when circumstances change.

There was strong agreement that, although BPM applies to abatement of discharges, it must also be seen to be applied to the entire waste management hierarchy and to operational matters. This is because lower discharges may result from waste minimisation measures or better controls on material handling than from further abatement of existing waste arisings.

It was suggested that a BPM study should be considered in a 'cradle to grave' context, otherwise decommissioning costs and doses could be very much higher than necessary or indeed decommissioning might be very much more demanding. Similarly, it was considered that although the BPM might change with time it might change less so if the 'cradle to grave' approach was used. In this regard, it was suggested that it may be possible on a complex plant to identify at the outset certain parts of a plant that require different time-line treatments (e.g. central components may be effectively fixed for the lifetime of plant so regular BPM reviews may focus on other parts capable of changes).

Participants who regulate some non-nuclear sites, such as hospitals, suggested that BPM starts at the design stage and this should consider the ability of a plant to be modified or equipment retrofitted (e.g. iodine delay tanks).

All participants agreed that proportionality is a very important concept in assessing BPM and that the demonstration of BPM should be proportionate. Some participants suggested there is a need to have a 'screening test' for scale to separate low consequence/low risk from high consequences. This scale would be useful for making judgements on what is or is not grossly disproportionate. One participant suggested that Cm 2919 provides such a test in the form of the 20 $\mu\text{Sv/yr}$ value (i.e. suggesting that proportionately less effort would be required if the dose is less than this). Most other participants disagreed with this concept, noting that the effort should be proportionate at any dose level that is within a constraint. Some participants expressed the view that they would be unhappy to link dose limits to BPM. Other proportionality tests were considered (e.g. based on absolute activity concentrations in discharges or relative to current authorised limits) but there was no agreement on the applicability of these either.

It was also agreed that a BPM study needs to take account of a wide spectrum of issues and risks. There was no agreement as to whether social factors, including 'public acceptability' are important factors that must always explicitly be considered in a BPM. This was considered to be true for BPEO but uncertain for BPM.

There was no agreement for the suggestion that a transparent method is needed to screen out options on the basis of excessive cost at an early stage of the BPM study. There was also disagreement as to whether it is acceptable for an operator to include in 'costs' an element of profit/loss or affordability.

Discussions at the non-nuclear site operators' workshops

Although a number of non-nuclear site operators attended the first operators' workshop, two further workshops (one in England and one in Scotland) were subsequently held specifically for representatives of non-nuclear sites to ensure their views were properly fed into the consultation programme.

Many of these key issues and topics raised at these workshops were the same or similar to those raised by participants in the previous operators' and Agencies' workshops, but often their significance or importance for non-nuclear site operators was different to those of operators of nuclear licensed sites. This may be because of the scale of the operations being undertaken, their potential for causing harm to the public and the environment, and the resource limitations on the some non-nuclear operators (in terms of qualified staff and funds).

Key points discussed were as follows.

Many participants were concerned that the expectations of the Agencies would be driven by precedence related to the spend and effort from the large nuclear licensed sites, and the Agencies may not appreciate the different (e.g. clinical) imperatives of many smaller non-nuclear operators. In this light, several participants expressed concern that the new BPM conditions in their authorisation would require considerable additional effort and expenditure on their part. Some participants suggested that the Agencies should commission a regulatory impact assessment to evaluate the impact to non-nuclear site operators.

A number of participants considered that Agency staff should attempt to communicate the requirements of BPM directly to managers (e.g. the senior administrators in health trusts) as well as to the qualified persons. Introducing BPM into the culture of some sites will need to come from senior management. This is because often the departments which produce waste in (e.g. in a hospital) are not holders of the budget for disposal. This may lead to difficulties when priorities differ and might be an obstacle to effective adoption of BPM.

Many participants considered that BPM could best be achieved on non-nuclear sites by improved management procedures, for example by ordering from suppliers small quantities of materials to limit the on-site inventory. Databases could be useful to encourage reuse or use of surplus materials across organisations. At present this is unlikely to happen due to the accounting principles often used at some non-nuclear sites that separate budgets for purchasing stock and disposal of waste.

Several participants considered that they were already doing many or all of the aspects of BPM under the existing conditions and limitations of their authorisation, even when it was not explicitly called BPM. The view was expressed that for many practices undertaken on non-nuclear sites it is very difficult to separate the concepts of BPEO and BPM for waste management and discharge abatement.

Some participants favoured more detailed and prescriptive guidance but this was not universally agreed. Most participants requested separate guidance be developed for non-nuclear sites that reflects their operations. Most participants considered that a generic format for undertaking BPM studies or standard calculations would be useful and would provide a proportionate approach given their level of resource.

There was considerable discussion on the application of proportionality to non-nuclear sites. Several participants suggested that proportionality arguments could be based on affordability rather than on undiscounted cost. For hospitals, it was argued that a BPM study and consideration of proportionality needs to take account of the clinical imperative of hospitals (e.g. to meet Government targets for cancer treatment) and their financial situation, and that this might mean a different evaluation of proportionality to that applied to other users for similar levels of discharges.

There was a similar debate about the requirement for a lower threshold for BPM studies. Many participants considered that a lower threshold was required, and it was suggested that the Cm 2919 20 $\mu\text{Sv}/\text{yr}$ optimisation level would be

appropriate to use, although other participants considered the concept of ALARA to be incompatible with the specification of a lower threshold.

It was commonly believed that it is hard to undertake meaningful dose assessments for some non-nuclear sites, particularly those in urban environments, because discharges from individual processes or locations (e.g. specific parts of a hospital or research facility) are not monitored or because critical groups are hard to define or because several sites discharge to the same drainage system.

Some concern was expressed that additional requirements to meet BPM could mean dose transfer from the public to workers. Guidance was requested on how to balance the demands of the HSE(NII) and the Agencies.

There was also some concern that the additional requirements to meet BPM would drive clinical treatment away from radioactive options towards the use on non-radioactive ones. Guidance was requested on how to balance the demands of the Agencies with clinical expectations.

There was widespread support amongst the participants for generic BPM studies which were thought to be most applicable to non-nuclear site operators with similar interests (e.g. hospitals). It was felt that information transfer and sharing could be significantly improved to assist with such BPM studies. A central source of generic BPMs and supporting technology reviews would be useful to support this aim and to communicate examples of good practice. It was suggested that the Agencies' websites could be used to promulgate information. Several participants suggested that Government agencies or departments should take a lead in developing generic BPM studies or technology reviews for specific groups of operators. There was also interest expressed by members of the Association of University Radiation Protection Officers (AURPO) that they might be able to do some work using member expertise to develop generic studies.

Many participants, particularly those from hospitals in urban environments, raised the issue of decay storage of aqueous liquids. Some participants from hospitals questioned the status of research by the environment agencies on this topic. There was some concern that changes to authorisations for the purposes of increasing decay storage be seen as chargeable variations. A policy statement from the Agencies was requested on containment versus dispersion to set the baseline for BPM consideration.

It was generally agreed that resource demands on some non-nuclear sites means that it is important that Agencies agree and adhere to a plan of feedback and response times for review. It was also widely agreed that an appeals procedure was needed at a local level for times when an operator felt that a decision by Agency staff was inappropriate.

APPENDIX III: THE CONSULTATION QUESTIONNAIRES

These are the questions included in the questionnaires sent to Agencies and operators as part of the consultation process described in Appendix II.

Questions sent to Agencies

1. What do you understand by the term 'BPM' and what do you consider to be the distinction between BPM and BPEO?
2. Do you consider current government policy on BPM to be clear and, if not, why not?
3. The UK Discharge Strategy endorses that BPM should be applied to discharges to the marine environment to ensure that they meet with the ALARA principle. In your opinion, does the wording in the UK Discharge Strategy accentuate or merely re-emphasise the importance of BPM in reducing the volume and activity of radioactive discharges?
4. Have you required site operators to produce evidence that links their application and use of BPM to provide demonstration that they are complying with ALARA?
5. What do you consider to be the relationships, if any, between BPM and other principles such as Strategic Environmental Assessment and BAT?
6. How similar, or different, in your view is the Agencies' regulatory approach to controlling radioactive waste management based on the application of the BPM principle to that used in IPPC regulation based on BAT?
7. Do you consider that the more prescriptive approach used in BAT would help Agency inspectors in their regulatory duties if a similar prescriptive approach was developed for BPM?
8. Do you think that site operators understand what is meant by and what to include in the scope of a BPM study?
9. What do you understand by the term 'proportionality' in relation to regulatory control of radioactive waste management using BPM? How do you think proportionality is best addressed and demonstrated in a BPM study submitted by the site operator?
10. Did you request these studies or were they submitted on the operators own initiative? If you requested them, did the operators agree with you that they were warranted?
11. Were these for (a) existing plants and operations, (b) new plants or operations or (c) decommissioning activities?
12. Were the BPM studies preceded or accompanied by other related submissions (e.g. BPEO, SEA)? Do you believe these were required?

13. What advice did you provide to the site operators about the scope and methodology for the BPM studies? Did you receive requests for further information or clarification? If so, how did you respond?
14. Did you have to ask the operators for additional information or clarification regarding their BPM submissions?
15. Were there any main points of disagreement between you and the operators? If so, what were they and how were these overcome?
16. Did you encounter any other problems during appraisals of the studies?
17. Had you been involved in BPM appraisals before?
18. What internal methods, procedures guidance, etc (if any) did you use as the basis for appraising the BPM study?
19. What external methods, procedures guidance, etc (if any) did you use as the basis for appraising the BPM study?
20. Did you seek assistance or advice from other Agency inspectors or from external contractors?
21. Did you feel a need to seek policy clarification during your assessment of the BPM studies?
22. Did you request details of social and economic factors from the operators?
23. Other than social and economic factors, what other factors did the site operator include to demonstrate that they were using BPM in a manner that was proportionate to the radiological risk?
24. Were any external stakeholders involved in either the BPM studies you received or in your assessment of them? If so, was this helpful? If they were not, do you think it should be considered in the future?
25. How prescriptive should guidance for inspectors on BPM appraisals be?
26. In your opinion, should such guidance be for inspectors only or should some of it be specifically intended to help operators?
27. What particular aspects do you consider should be included in the guidance?
28. In the future, should site operators be told that the effort they devote to BPM studies should be proportional to the scale of the problem/level of environmental risk? This could, for example, relate to levels of discharges, levels of doses, and cost of the plant/operation.
29. What issues do you consider Agency inspectors should take account of when determining whether the conditions and limitations in licence conditions are proportionate to the radiological risk?
30. Do you think BPM studies for decommissioning operations are or will be more difficult than those for current plant and operations? If so, what

features would guidance for decommissioning BPM studies have that are not needed for current plant and operations?

31. Do you think separate guidance is required for BPM studies for licensed and non-licensed nuclear sites?
32. Do you think BPM studies for existing plant and operations are more difficult than those for new plant and operations? If so, what features would guidance for BPM studies for existing plant and operations particularly need to have?

Questions sent to operators

1. What do you understand by the term 'BPM' and what do you consider to be the distinction between BPM and BPEO?
2. What do you understand to be the meaning of BPM and which references would you refer to for its definition?
3. Are BPM conditions included in any Certificate of Authorisation issued by your regulator under the Radioactive Substances Act, 1993 that is currently in force?
4. Do you carry out BPM studies only when requested or required to do so by the regulator, or do they have a role in your own health, safety and environmental management system for your facilities?
5. The UK Discharge Strategy endorses that BPM should be applied to discharges to the marine environment to ensure that they meet with the ALARA principle. In any BPM submission, how would you seek to demonstrate the link between BPM and ALARA?
6. What do you consider to be the relationships, if any, between BPM and other principles such as Strategic Environmental Assessment and BAT?
7. Do you use any proforma or any prescribed procedures or guidance (both internal and external) to ascertain what information to include in a BPM study, or is the scope of work for the BPM study decided on a case by case basis?
8. What do you understand by the term 'proportionality' in relation to regulatory control of radioactive waste management using BPM? How do you think proportionality is best addressed and demonstrated in any BPM study you submit?
9. When in your planning process did you begin BPM-related studies?
10. What set of circumstances would trigger the start of a BPM study?
11. Were these for (a) existing plants and operations, (b) new plants or operations or (c) decommissioning activities?

12. Was it made clear to you by the regulator why the BPM studies were required? Who in your organisation or at the regulator decided whether BPM studies were necessary?
13. Did you agree with the Agencies that BPM studies were required or did you think that they were unnecessary?
14. What other related submissions have you made or do you plan to make in support of your operations (e.g. BPEO, SEA)? If you have not previously submitted a BPEO study, why did you consider this to be unnecessary? Did the regulator agree a separate BPEO study was not required?
15. What advice did you receive from Agencies about the scope and methodology for the BPM studies? Was the advice sufficient? Did you request further information or clarification? If so, how did the regulator respond?
16. What did the Agencies tell you about how they would assess your BPM studies? Did this help you?
17. Did you seek assistance in undertaking BPM studies from your organisation's in-house capabilities, other operators, or from external contractors? If you used external contractors, did you feel you retained control of the direction and scope of the BPM study?
18. How easy was it to identify and assess relevant technologies?
19. Did you use multi-attribute methodologies or something else?
20. Did you consider non-radioactive discharges and wastes in your studies?
21. Did you take social and economic factors into account? If so, how and at what stage?
22. How did you take account of costs in the studies? Did you treat cost as just another factor or as something separate?
23. Did you feel that the BPM studies were worthwhile or a waste of time?
24. What were the major problems you encountered during the studies?
25. In your view, what were the major benefits of carrying out such studies?
26. Can you estimate how much it cost (time and money) to carry out your BPM studies? Do you consider this cost proportional to the benefits gained in terms of environmental protection?
27. Other than social and economic factors, what other factors would you include in a BPM study to demonstrate that you were using BPM in a manner that was proportionate to the radiological risk?
28. Did you learn anything new about your plant or processes by carrying out the BPM studies?
29. Had you been involved in BPM studies before?

30. Did you involve any external stakeholders in your studies? If so, was this helpful? If you did not, would you consider it in the future?
31. Do you consider that it is worthwhile to discuss the scope and methodology for a proposed BPM study with the regulator prior to starting the study
32. Do you consider that there are benefits or disadvantages in meeting the Agencies on a regular basis during BPM studies?
33. Did you have a continuous dialogue with the Agencies or did contact only take place after submission of the studies? Was this your decision or theirs?
34. Did the Agencies respond in detail to your BPM studies?
35. Were their responses prompt?
36. Did they accept what you had done or require you to undertake further work? If the latter, what was the nature of this further work and did you accept that it was warranted?
37. What could the regulator do to make future BPM studies simpler and less costly to perform?
38. Would you welcome the development of a Guidance Document for Agencies? To what degree do you believe any guidance should be prescriptive? Do you believe this guidance should be solely for Agencies or should it also be intended for operators?
39. Should the effort devoted to future BPM studies be proportional to the scale of the problem? If so, how would you define 'scale'? This could, for example, relate to levels of discharges, levels of doses, and cost of the plant/operation.
40. Do you think BPM studies for licensed and non-licensed nuclear sites should be different in scope and detail?
41. Do you think BPM studies for decommissioning operations are or will be more difficult than those for current plant and operations? If so, how could the regulator help you with these?
42. Do think there is a place for peer review in the BPM process ?

APPENDIX IV: THE HISTORY OF BPM IN ENVIRONMENTAL LEGISLATION

The concept of BPM as applied to environmental protection has its origins in the 1863 Alkali Act which was introduced to control, at alkali works, discharges into the atmosphere of hydrochloric acid from the manufacture of sodium carbonate from common salt. The Act was introduced in response to concerns about the effects of acidic pollutants on the environment, particularly plant life, and, to a lesser extent, public health. The original Act was successful in reducing discharges of hydrochloric acid but it later became evident that other gases such as sulphuric acid and chlorine were causing greater environmental damage.

In response to this, the legislation was re-enacted in 1874. The new Act extended the list of controlled pollutants and introduced the principle that each operator should be required to take all reasonably practicable measures to reduce the quantities of polluting substances discharged. The legislation was further extended and amended in subsequent years and the changes were consolidated into the Alkali Works Regulation Act 1906 which required the operator to:

“Use the best practicable means for preventing the escape of noxious and offensive gases by the exit flue of any apparatus used in any process carried on in the work, and for preventing the discharge, whether directly or indirectly, of such gases into the atmosphere, and for rendering such gases where discharged harmless and inoffensive.”

The effect of this was to place a requirement on the operator to apply BPM not just to the plant and equipment in place for treating potentially polluting gases or the arrangements for releasing them into the atmosphere but also to the prevention of the escape of the gases from the process itself. Records of the operation of the Alkali Act over the years make clear that it was interpreted to include waste minimisation through process design as well as methods of plant operation.

No guidance was provided along with either of these Acts on the meaning of BPM and, therefore, the words were taken to have their normal English language meaning, which in the case of practicable is *‘capable of being put into effect’*. From the time of the 1863 Act, however, it was accepted that any assessment of what was practicable should take account of economic factors as well as technical ones. Generally, economic factors were taken to relate to the business viability of the operator, rather than proportionality between cost and benefit.

This definition of practicable was used for the next few decades until the regulators of the day applied the meaning prescribed in the Clean Air Act 1956:

“practicable means reasonably practicable having regard, amongst other things, to local and current conditions and circumstances, to the financial implications and to the current state of technical knowledge.”

This application and interpretation of BPM broadly remained unchanged up until the 1970s, when the Royal Commission on Environmental Pollution (RCEP) reviewed methods for controlling air pollution. The RCEP in their 5th report [RCEP, 1976a] endorsed the application of BPM, considering it to be suitably flexible to achieve a sensible balance between cost and benefits, and favouring it

over a system of fixed discharge limits. The RCEP then made a number of recommendations for BPM to be applied more effectively:

- regulators must be capable of understanding financial and economic issues, as well as scientific and technical ones;
- BPM studies should use an open approach that allows the views of relevant stakeholders to be taken into account; and
- BPM studies and supporting arguments should be recorded and made publicly available.

A further recommendation of the RCEP was that the concept of BPM should be extended to cover discharges of liquid pollutants and solid waste arisings, in addition to discharges to the atmosphere, to ensure that all polluting discharges are minimised using BPM to provide the 'best practicable environmental option'. The considered view of the RCEP at that time (1976) was that BPEO was the outcome of the application of the traditional BPM approach extended to cover all waste arisings and applied with regard to the effects of the releases on the environment as a whole.

The RCEP's recommendation to extend BPEO and BPM-type approaches to cover all forms of non-radioactive discharge was implemented in the Environmental Protection Act 1990, which provided for the introduction of Integrated Pollution Control (IPC). Rather than, however, applying the existing concept of BPM to control non-radioactive discharges, IPC introduced the broadly similar concepts of 'best available technology' (BAT) and 'best available technology not entailing excessive costs' (BATNEEC) which are discussed in Section 3. From the time the Environmental Protection Act 1990 was enacted, BPM has been used only in authorisations issued under the Radioactive Substances Act, discussed below.

BPM in legislation for radioactive waste management

Since the 1960s, the control of disposals and discharges of radioactive materials has been regulated separately from non-radioactive pollutants under the Radioactive Substances Act.

The Agencies implement the Act through conditions and limitations attached to authorisations and registrations to keep, use, discharge or dispose of radioactive substances at nuclear licensed and non-nuclear sites. The Radioactive Substances Act, however, makes no direct reference to BPM (or BPEO). As a consequence, the Act allows the Agencies to grant authorisations for the disposal of waste subject to such limitations and conditions as they see fit. The requirement to use BPM has featured in some authorisations under the Radioactive Substances Act since the first version of the Act came into force in 1960 (RSA'60). A consolidated Act was introduced in 1993 (RSA'93). The inclusion of BPM in authorisations is, however, a matter of policy rather than law, and the Agencies maintain discretion over the meaning to be given to it in this context.

The requirements of the BSS Directive have been transcribed into the environmental regulatory framework through The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000 from Government to the

Environment Agency (there is a similar direction to SEPA) which requires, amongst other things, the Agencies to ensure that exposures of members of the public and the population as a whole resulting from the disposal of radioactive waste are kept ALARA, economic and social factors being taken into account. The Agencies meet these requirements by BPM and BPEO to exert control over radioactive substances.

Similar to the way BPM was first applied to non-radioactive pollutants, early authorisations for radioactive discharges from nuclear licensed sites relied upon BPM to limit discharges to the atmosphere whilst disposals of liquid waste were controlled solely by numerical limits applied to specific radionuclides or groups of radionuclides.

This regulatory approach was criticised by the RCEP in their 6th report [RCEP, 1976b] as being inconsistent. The Agencies at the time subsequently added numerical limits to gaseous discharges and introduced a clause into all authorisations relating to gaseous and liquid waste requiring the operators *'by the use of such means as are approved by the Secretary of State to ensure that the radiological significance of the waste discharged is as low as is reasonably achievable'*. The intended purpose of this was to bring UK policy in line with the International Commission on Radiation Protection's (ICRP) recommended principle of optimisation of protection.

A later review of the nuclear site authorisations concluded, however, that this new condition should be replaced with a general requirement on operators to apply BPM to control all radioactive waste arisings and discharges. This was because it was considered inappropriate for the Secretary of State to approve operations authorised under the Radioactive Substances Act and because it was considered unacceptable to impose on operators conditions that related to matters that were wholly or partly outside their control, and the radiological significance of wastes discharged was considered to be one such matter.

In response to this, new conditions and limitations were included in authorisations granted by the Agencies that require BPM to be used by the operator to minimise both the volume and the activity of radioactive waste produced that will require disposal and to minimise the volume and activity of gaseous and aqueous radioactive waste discharged to the environment.

APPENDIX V: CONDITIONS AND LIMITATIONS IN AUTHORISATIONS AND REGISTRATIONS

The Agencies are charged with enforcing the requirements of RSA'93 and do this through the inclusion of specific conditions and limitations in the registrations and authorisations they grant that require operators to use BPM to minimise waste arisings and discharges.

The main conditions and limitations that apply are set out below.

Conditions and limitations in authorisations granted under RSA'93 to nuclear licensed sites

All new authorisations for nuclear licensed sites granted by both the EA and SEPA will, in future, be based on a common template multi-media certificate of authorisation and will contain the following conditions relating to BPM :

'The operator shall use the best practicable means to minimise the activity of radioactive waste produced that will require disposal under the authorisation.

The operator shall use the best practicable means to:

- minimise the activity of gaseous and aqueous radioactive waste disposed of by discharge to the environment;*
- minimise the volume of radioactive waste disposed of by transfer to other premises;*
- dispose of radioactive waste at times, in a form, and in a manner so as to minimise the radiological effects on the environment and members of the public.'*

In addition, the authorisation requires the operator to use BPM when taking samples and conducting measurements, tests, surveys and calculations to determine compliance with the limitations and conditions of the authorisation. The authorisations specify that, where reference is made to the use of BPM, the means to be employed shall include:

- *the provision, maintenance and manner of operation of any relevant plant, machinery or equipment; and*
- *the supervision of any relevant operation.*

Other specific conditions may be included in an authorisation that require the operator to use BPM for additional purposes.

The Agencies set out their interpretation of BPM in the certificates of authorisation as:

'In determining whether particular means are the 'best practicable' for the purposes of this Authorisation, the Operator shall not be required to incur expenditure whether in money, time or trouble which is, or is likely to be, grossly disproportionate to the benefits to be derived from, or likely to be

derived from, or the efficacy of, or likely efficacy of, employing them, the benefits or results produced being, or likely to be, insignificant in relation to the expenditure.

Where reference is made to the use of 'best practicable means' in this Certificate of Authorisation, the means to be employed shall include:

- the provision, maintenance and manner of operation of any relevant plant, machinery or equipment;*
- the supervision of any relevant operation.'*

Within the condition, the phrase 'expenditure of time, money or trouble' is a legal phrase derived from case law and is central to the concept of proportionality which underpins BPM.

For existing plant and processes, the Agencies will require the operator to make progressive improvements in waste management methods and reductions in discharges, and production and disposal of other radioactive waste. The standard conditions thus require the application of BPM on a continuing day-to-day basis and, to demonstrate compliance with the conditions, the Agencies may require the operator to carry out BPM studies for particular plants or operations on the site, and the Agencies require the operators to provide them with:

'a full report of a comprehensive review of national and international developments in best practice for minimising all waste disposals, together with a strategy for achieving reductions in discharges'.

This review and strategy are directly relevant to the Agencies assessment as to whether the operator's current plant and practice represent the BPM.

The consideration of BPM in setting discharge limits for nuclear licensed sites is addressed in draft EA guidance to its inspectors [Hill and Kerrigan, 2003]. The guidance states that the Agencies' BPM assessments would typically be carried out between the regular reviews of authorisations. The outcomes of the BPM studies would feed into the review of the authorisation and contribute to the setting of discharge limits.

Judgement as to whether or not the operator is using BPM to minimise discharges is generally exercised on the level of discharge achieved. All new authorisations under the multi-media template will set quarterly notification levels (QNLs) on discharges. If a QNL is exceeded, the operator must provide the Agencies with a review having regard to the requirements placed on the operator to use BPM.

BPM in registrations granted under RSA'93 to non-nuclear sites

The EA included a requirement in all non-nuclear authorisations in November 2003 that the users of radioactive material employ BPM to:

- (a) minimise the activity in all disposals of radioactive waste;*
- (b) where requested for authorisation, minimise the volume of radioactive waste disposed of by transfer to other premises;*

(c) dispose of radioactive waste at times, in a form, and in a manner so as to minimise the radiological effects on the environment and members of the public.

In view of this decision, in November 2002 the EA issued interim guidance on BPM for non-nuclear users [EA, 2002]. The guidance outlines what the user is expected to do to demonstrate that BPM are being or will be applied. This involves reviewing current and planned practices, assessing possible changes to them, and providing the EA with such appropriate documentation. Additional guidance is currently being prepared.

SEPA has recently introduced standard conditions relating to BPM in new certificates of authorisation for the accumulation and disposal of radioactive waste by users on non-nuclear sites which require that:

'BPM shall be used to minimise the volume and activity of authorised waste produced; and

BPM shall be used to minimise the activity of authorised waste disposed or discharged'.

SEPA has amended its registration certificates for the keeping or use of radioactive material to include a requirement that BPM be used to ensure that no unnecessary radioactive waste is generated. To this effect a clause has been added in certificates about the keeping and use of sources that states *"The Registered Person shall take all practicable measures to ensure that unnecessary radioactive waste is not generated as a result of the keeping or use of the registered substances"*.

In Northern Ireland, the Chief Radiochemical Inspector has introduced standard conditions relating to BPM in new Certificates of Authorisation on non-nuclear premises which require that:

'The user shall use BPM to minimise the activity of radioactive waste produced that will require disposal under the Certificate of Authorisation.

The user shall use BPM to:

- minimise the activity of gaseous and aqueous radioactive waste disposed of by discharge to the environment;*
- mitigate the radiological effects of any discharge on the environment and members of the public; and*
- minimise the volume of radioactive waste disposed of by transfer to other premises.'*