

The NDA Value Framework

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1.0 Introduction

To ensure transparency when comparing and assessing options, the Nuclear Decommissioning Authority (NDA) has established an approach to the way it values its business, recognising that value comes in many forms, such as: an improved environment, risk or hazard reduction, social amenities, money or employment. These values have been gathered together as a Value Framework. This Value Framework supports the NDA's aim to deliver safe and sustainable solutions to the challenge of nuclear clean-up and waste management. This means:

- never compromising on safety or security;
- taking full account of our social and environmental responsibilities;
- always seeking value for money for the taxpayer;
- actively engaging with stakeholders.

Previous versions of the Value Framework have been used to support the development of Business Cases, in order to demonstrate that the NDA is delivering value for money across its entire estate [1, 2]. It is recognised, however, that there are many reasons for comparing options. These include the requirement to ensure that practices on nuclear licensed sites are consistent with the principle of ensuring that impacts are As Low As Reasonably Achievable (ALARA) and through application of Best Available Techniques (BAT¹); and for policy, planning and programme making to undertake a Strategic Environmental Assessment (SEA).

This update of our Value Framework is a response to our commitment in Strategy II to “develop a comprehensive and consistent set of relevant factors for consideration during decision-making” [3]. The Value Framework provides a tool that meets the requirements for optimisation and optioneering across a broad range of applications.

1.1 Purpose and scope

Currently, there are many guidance documents available presenting factors to be considered when assessing options. These include HM Treasury Green Book [4] and the Nuclear Industry Code of Practice on BAT [5] as well as documents issued by the NDA [2], the Office of Nuclear regulation (ONR) [6], the Environment Agency [7] and other UK [8] and international bodies [9].

The purpose of this document is to provide guidance on the Value Framework and to demonstrate to stakeholders the values used in the NDA's decision-making processes. The intention of this document is not to describe the decision-making process, but to guide the reader on options assessment, a key step in the decision-making process.

At the heart of this guidance lie the factors to be considered when assessing options. **Discussion of these factors** is a key part of the assessment process. The Value Framework

¹ In Scotland, the equivalent requirement is to apply Best Practicable Means (BPM).

is not intended as a mandatory checklist with all factors always being included. **Only relevant factors should be considered** and **the approach should be proportionate** to the nature of the issue being addressed. The Value Framework offers a way to present a rational assessment of the advantages and disadvantages of each option at varying levels of detail.

1.2 Context

Options assessment can be characterised as a logical comparison of alternatives based on consideration of a range of factors with the aim of identifying a single option that is preferred within the context and constraints of the project, programme or activity.

The Value Framework provides only one input within the decision-making process (see Figure 1), where the broad approach is to:

- define the issue to be addressed;
 - what are you trying to achieve?
 - what are you trying to avoid?
- identify all potential options (note that 'do nothing' or 'do minimum' options should always be considered);
- screen options to produce a 'short-list' of credible options for further consideration;
- assess credible options and identify a single preferred option;
- review and implement the preferred option.

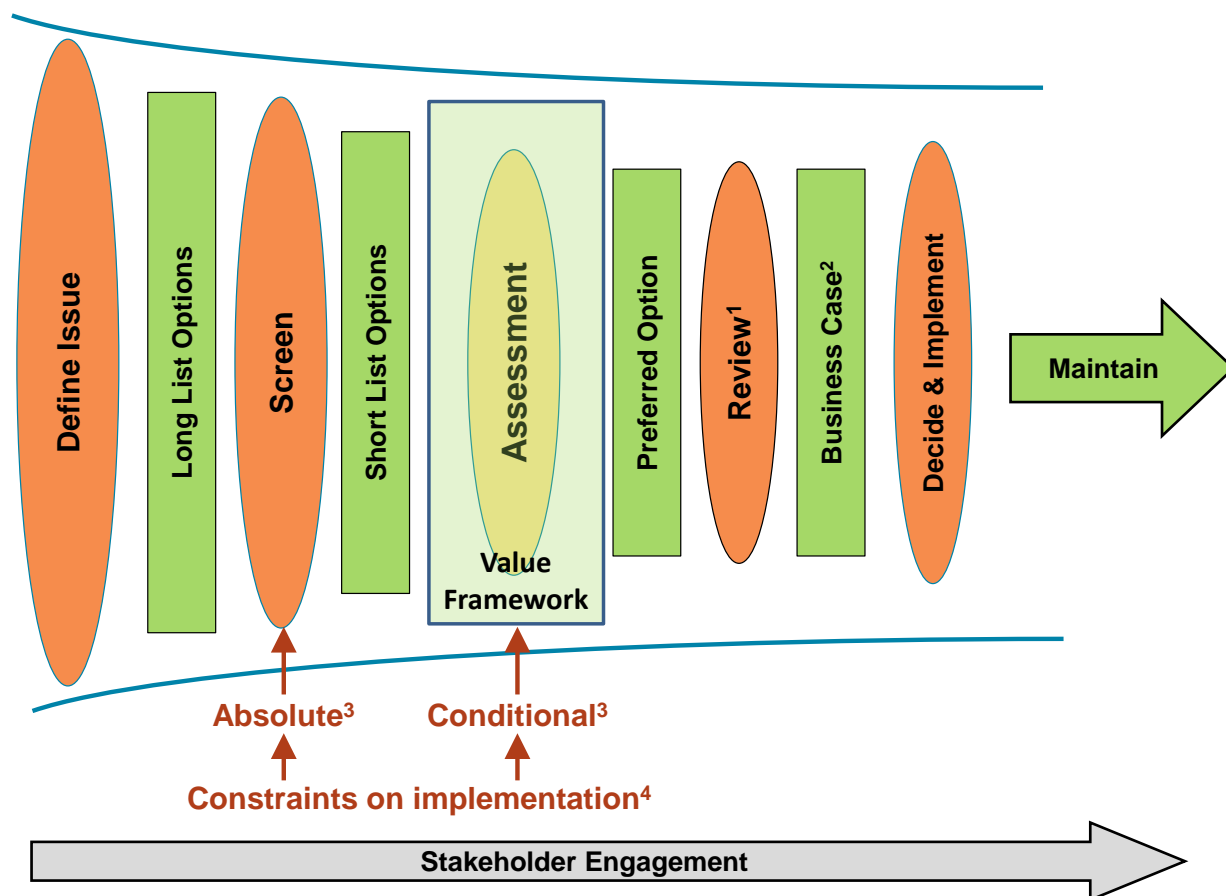
This process has the aim of reducing uncertainty as the decision comes closer to being made, as identified in the NDA strategic process.

Throughout, it is noted that selection and implementation of options may:

- be *constrained* by practical considerations (e.g. time, upstream/downstream facilities or projects, competing priorities) or by National/International strategies & obligations;
- be dependent on *assumptions*;
- proceed through a number of stages ('gates').

The options assessment may itself be iterative, depending on the nature and complexity of the issue, but implementation of decisions always requires final sanction. This final sanction may not be forthcoming due to competing demands on funding at a higher level (such as government funding).

Figure 1: Flowsheet illustrating application of the Value Framework within the decision-making process



- 1 Review of assumptions and constraints used to identify the preferred option.
- 2 The Business Case adds the financial, management and commercial case leading to implementation, as identified in HM Treasury Five Case approach [10].
- 3 The concept of 'absolute' and 'conditional' constraints is discussed further in Section 3.2.
- 4 Options must be tested to ensure that they can be implemented, see Section 2.2.

2.0 The Value Framework

There are a number of methods that may be used for assessing options. These methods vary in complexity, and consequent time and effort involved. The purpose, in each case, is to present an evidence based comparison of alternative options, identifying the preferred option within the context of the project, programme or activity, to inform decision-making.

The options assessment may be either qualitative (based on discussion) or quantitative (based on a numerical scoring system), or a combination of both. Where a qualitative assessment is undertaken, based on reasoned argument, it will be supported by factual

information. The nature of the assessment will depend on the options under consideration, the importance of the assessment and the timescale required for decision-making.

In all cases when carrying out option assessments it is important that:

- a consistent, systematic and transparent approach is used with clear definitions of the criteria that are being considered as part of the assessment;
- adequate time is allocated to describe each option and to obtain underpinning information;
- the assessments are evidence based, and the evidence supports the conclusions reached;
- options are assessed based on consideration of their full life cycle impact;
- risks and uncertainties are considered, in particular it is important to understand the consequences if an option does not perform as anticipated and hence whether the risk outweighs the potential benefits from implementation.

It is also important that assessments are free from bias, whether conscious (e.g. having a preferred outcome declared in advance) or unconscious (e.g. by having different levels of information available to underpin different options).

2.1 Value Framework factors

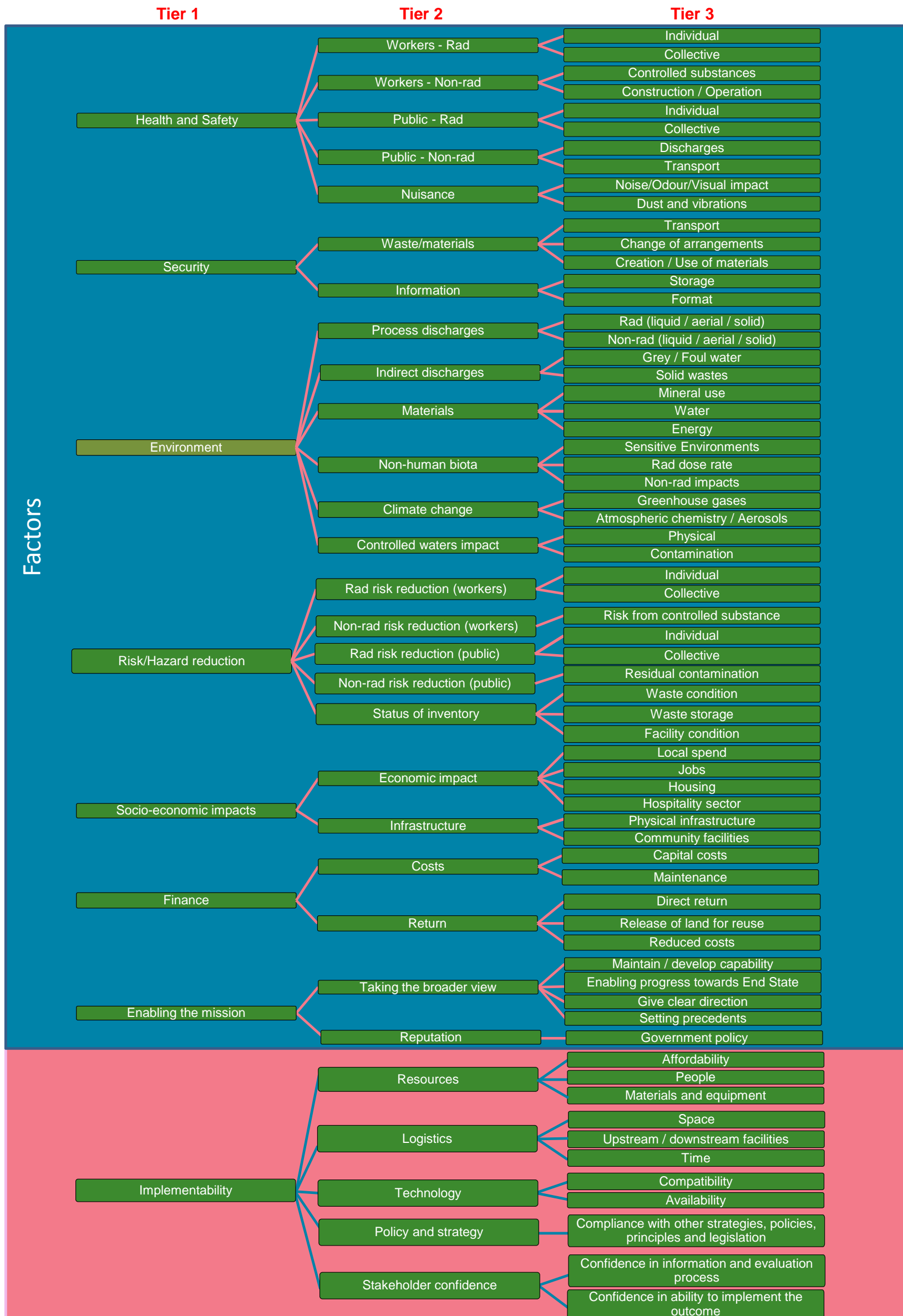
The Value Framework promotes a clear and consistent presentation of evidence to compare a range of options based on:

- Health and Safety
- Security
- Environment
- Risk / Hazard Reduction
- Socio-economic impacts
- Finance
- Enabling the Mission

Since the number of specific factors that may be considered is large, a tiered approach is adopted, with increasing levels of detail. There may be linkages and interactions between these factors that should be considered, however double-counting should be avoided (see Section 3.6.1).

No list of factors can ever be considered exhaustive and, in theory, most factors *could* be used for either screening or evaluation. Consequently, Figure 2 provides a useful tool to identify factors of relevance but it should not be regarded as 'set in stone'.

Figure 2: Illustrating the Value Framework tiered approach



Appendix 1 also identifies these factors and provides a fuller description. If a particular factor is not relevant it may be discounted (with a brief justification). Conversely, a factor of relevance to a specific decision may be added to this list. The broad Tier 1 factors are discussed below.

2.1.1 Health and safety

Health and Safety relates to the level of harm associated with implementing the option. This factor covers performance of the work, whereas health implications associated with the time-period after the option has been completed are considered under 'Risk / Hazard Reduction' (Section 2.1.4). We have taken this approach within the Value Framework to ensure that the full lifecycle of effects is accounted for. An increase in short-term risk may provide overwhelming benefits in the long-term and hence be justified. Taking this approach, Health and Safety factors include dose to workers and risk of falls from undertaking decommissioning, as well as risk to public of accidents associated with lorry moves around the country.

Safety, and provision of safe working practices, is a requirement within primary legislation. When considering any option, it is a requirement that a risk assessment be carried out to produce safe systems of work, and ensure that the risk of accidents and injury to any individual are kept As Low As Reasonably Achievable (ALARA²). At the same time, the distribution of dose or risk across individuals or over time, and exposure to hazardous substances, requires consideration. In this context, the concept of 'collective dose' (i.e. the total dose to a defined population over a defined period of time) may form a useful consideration in terms of establishing a 'cost-benefit' argument.

Impacts on the environment are addressed separately (see Section 2.1.3) and double-counting these environment issues and health and safety issues should be avoided (see Section 3.6.1).

2.1.2 Security

All licensed sites and Government facilities are required to have a security plan by law. Security concerns are driven by a facility's contents and the threats these contents pose if they were to get into the wrong hands. As such, the creation and management of waste and materials may require consideration, as well as access to information regarding such wastes and materials.

2.1.3 Environment

The environment may be considered to include both the living and physical surroundings of an area, and their interactions. Impacts on the local environment include the impact of

² Regulatory conditions may use other terms that have similar, but distinctly formulated, definitions. For ease here, the ALARA principle is taken to be equivalent to the requirement to maintain risk As Low As Reasonably Practicable (ALARP) or So Far As Is Reasonably Practicable (SFAIRP) as used in other regulatory regimes.

radiological and non-radiological discharges on wildlife, and potential contamination of controlled waters, including groundwater and surface water. Consideration of the environment is an important issue, and a range of factors may be relevant. It is recognised that there is considerable complexity in understanding and assessing the causal links between a policy, its effects on ecosystems and related services, and then valuing the effects in economic terms. Guidance is available from the Natural Capital Committee [11].

The environment is multi-faceted and provides, amongst other things:

- a place to live;
- natural resources, such as clean air and water;
- the foundation for industry, agriculture, tourism and recreation (for example, through access to green spaces).

In general terms, use of materials, impacts on ecosystems, contributions to climate change and contamination of controlled waters all represent potential environmental impacts. In some instances, local issues, such as loss of habitat, may have a regional or national importance. For example, an impact on endangered species can be considered to be a national issue even though the impacts occur at a local level. Specific consideration is required if any development may impact on designated sites, such as Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs) for Birds, Special Areas of Conservation (SACs), national parks or other habitats covered by the European Habitats Directive. Where degradation of such sites is justified and unavoidable, there may be a requirement to create equivalent replacement habitat.

SLC's and other companies often have limits set on both radiological and non-radiological discharges by regulators. However, discharges should not simply be pushed down the supply chain, unless there is an overall benefit. Furthermore, the quality of discharges as well as their quantity should be considered, particularly when considering indirect discharges such as foul or grey water.

The NDA also notes that the reason for limits to discharges is to prevent adverse effects to humans and the environment. Therefore, care is required that discharges are not double-counted with factors such as 'Impact on non-human biota', 'Impact on climate change', 'Impact on controlled waters' and Health and Safety considerations.

2.1.4 Risk and hazard reduction

Risk and hazard reduction relates to factors that lead to a decreased risk or hazard after the implementation of an option. In particular, we wish to know how much the risk to people has been reduced following the implementation of an option. Reduction of risk can be achieved through either reduction of the inventory (removal from site) or passivation of inventory (as a consequence of shielding or facility condition).

Whether something is considered a risk, or otherwise, depends on the circumstances prevailing at the time and the perspective of the observer. Risk and hazard should both be

considered, where risk reflects the likelihood of occurrence as well as the potential impact arising from a hazard³. For example, the volume and radiological inventory of a waste may define its hazard, whereas the form and location of the waste may define its risk. Risk reduction may also be relevant to the risk that the public or workforce do not receive as a result of the implementation of an option (the averted risk). In other words, the long-term benefit derived from the implementation of an option (both radiologically and non-radiologically).

As part of the development of the NDA prioritisation process a consistent means of expressing the concern generated by different facilities was created: the Safety and Environmental Detriment (SED) score [12]. This score has been used across the NDA estate, and takes account of the potential impact of the stored material being released into the environment along with its conditions of storage. The SED score provides one way of indicating the threat or concern posed by a facility, accounting for the physical and chemical form of the material, the age of the building that the material is in, and uncertainties regarding the condition of the waste material. The SED score can be useful in a broad comparison of different sites. However, the SED score is heavily influenced by a subjective judgement of the facility and waste condition. Separate consideration of the aspects contributing to the SED score, such as the physical or chemical form, may also prove insightful. For example, the treatment of a large volume of solid VLLW will be very different to the treatment of a small volume of gaseous HLW, despite both wastes having the same SED score.

Other approaches to quantifying risk may also be appropriate, notably the evaluation of off-site consequences.

Where there are fewer cross-comparisons to be made (e.g. of sites or facilities) a more specific approach to quantifying risk may be preferable to use of the SED score, which provides a rather broader based tool. In any event, the key word in this factor is 'reduction' and hence progress towards the end state. Care should be taken to avoid double-counting with factors considered under 'Enabling the mission.'

2.1.5 Socio-economic impacts

The NDA's mission is to remediate and close down the sites for which it is responsible. Whilst this mission is the NDA's primary consideration, the NDA takes seriously its commitment to local communities. This commitment may include directly creating or maintaining employment, but may also include the less direct impacts on tourism, the hospitality sector (hotels, B&Bs, restaurants, etc.), infrastructure (transport, hospitals, schools), and other community aspects. Moreover, for national or strategic issues, consideration of *where* to invest may be relevant, because many nuclear sites are situated in areas of low alternative employment. The NDA also acknowledges that impacts on the community will extend beyond

³ We note that there is often a confusion with this terminology in common parlance. In this document, hazard is something that can cause adverse effects. Risk denotes an overall measure of the likelihood that a hazard will actually cause its adverse effects **together** with a measure of the effect. Risk is a two-part concept and you have to have both parts to make sense of it.

the period of final site closure, emphasising the need to consider the full lifecycle implication of options.

Defra include additional dimensions reflecting socio-economic well-being not identified in this section [13]. Some of these relate to factors often described as 'nuisance factors', such as the noise produced by an option, the visual impact of an option, or the amount of dust an option produces. In this Value Framework, these factors are included as measures of overall 'Health and Safety', recognising that health encompasses mental, physical and social well-being.

2.1.6 Finance

What does 'finance' cover?

Finance is not only about cost (see Financial Case section of [2]). Direct and indirect, short- and long-term returns on spend should be considered. For example, a more costly option that enables earlier site de-designation may present an overall financial advantage compared to a less expensive option with deferred site de-designation, depending on the next planned use and value of the recovered land.

It is important that finance covers the full lifecycle implications of an option and not just the immediate cost of implementation. For example, consideration should be given to the cost of doing the work, maintaining the asset and physical controls, maintaining institutional controls, cost of decommissioning in the future, and so forth. Cost profiles over time, and hence approaches to discounting of spend, will also be relevant.

Costing options

Guidance is available on approaches to costing. HM Treasury, Defra and DECC have produced manuals to supplement their Green Book, accounting for environmental impacts, the effects of climate change and Social Cost Benefit Analysis (SCBA) [14, 15, 16, 17, 18].

Some considerations to be borne in mind are presented below.

- It is conventional to consider separately capital and revenue costs. In this case, capital costs can be regarded as 'one-off' costs, whereas revenue costs represent recurrent costs and include, for example, operational costs and preventative or corrective maintenance costs. Confusion between the two may arise where maintenance involves replacement, addition or modification costs, because these are strictly 'future capital' costs. The purpose here is not to determine a complex financial plan, but to ensure that the full lifecycle costs of options are compared on a like-for-like basis.
- Cost estimation for a project, programme or operation is not an exact science and the nature and accuracy of a cost estimate should be considered when comparing options, especially as this may introduce an unintentional bias. Typically, a cost estimate will be expressed within bounds of uncertainty or as a Class of estimate. A preliminary estimate may offer a degree of accuracy no better than an order of magnitude, whereas a more detailed estimate may be presented in the form of £x +40%/-20%. Cost estimates for a mature technology versus an emerging technology, or an existing strategy versus an evolving strategy, may reflect the level of development. If a single

cost value (e.g. the central value) is compared between the options it may unwittingly lead to a false conclusion that one or other option offers a financial advantage.

- Alternative approaches to discounting may be appropriate in different circumstances. HM Treasury's Green Book [4] offers a standard discount rate of 3.5% per annum⁴, but also offers guidance on how the discount rate should be applied over the long term (e.g. periods greater than 30 years). The Green Book also advises on circumstances where non-standard discount rates should be applied, such as lower discount rates for long-term decisions. Again, the purpose is not to determine a complex financial plan, but to ensure that the full lifecycle costs of options are compared on a like-for-like basis.
- Costs and benefits incurred prior to the point of assessment should be treated as 'sunk' and should not be considered as part of the main appraisal.
- A decision to do nothing, or to delay action, may have an effect further downstream that needs to be taken into account.

Depending on the issue under consideration, the range of alternative options available to be assessed and uncertainty in cost projections, sensitivity analysis may be applied to financial estimates. That is, the judgement between options may be evaluated in the light of a range of financial assumptions. This does not need to entail complex statistical assessment, and may be addressed through asking 'what if' questions. Again, proportionality should be a key consideration for this sensitivity analysis. The level of assessment required will depend on the significance of the options assessment, and levels of uncertainty.

2.1.7 Enabling the mission

We currently group our work under the following five strategic and delivery themes [19].

- Site Decommissioning and Remediation - to decommission and remediate our designated sites and release them for other uses.
- Spent Fuels - to ensure safe, secure and cost-effective lifecycle management of Spent Magnox, Spent Oxide and Spent Exotic fuels.
- Nuclear Materials - to ensure safe, secure and cost effective lifecycle management of our nuclear materials.
- Integrated Waste Management - to ensure that wastes are managed in a manner that protects people and the environment, whilst complying with UK Government and Scottish Government policies and providing value for money.
- Critical Enablers - to provide the stable and effective implementation framework that enables the delivery of our mission.

Enabling the Mission offers an opportunity to consider whether a specific action helps the NDA to deliver its ultimate mission of safe, efficient and cost-effective decommissioning of its sites. For example, does the option help to:

⁴ Technically, this value is a "social time-preference rate" consisting of a 2% rate accounting for expected economic growth in the long-term, and a 1.5% factor to account for the public's desire for current consumption over future consumption. See Annex 6 of the HM Treasury Green Book for a full derivation [4].

- Deliver the Mission? How far does any option demonstrate, or offer opportunities for, progress towards strategic objectives?
- Develop Capability? Does the option develop the capability of the UK nuclear workforce?
- Demonstrate Leadership? Does the option demonstrate a clear direction for the clean-up of the UK's nuclear legacy?

The key question is “*does this make the ongoing mission easier or harder?*” Options may be considered in terms of whether they enable progress towards strategic objectives, for example by setting helpful precedents and giving direction to future activities, by developing and maintaining the skills and knowledge necessary to decommission sites, by creating space or releasing resource for other decommissioning projects, by testing new technologies, or by making visible progress that improves the reputation of the industry and gains the confidence of stakeholders. Note that explicit progress towards the Site End State as a result of implementing the option should not be considered here because this factor is captured under risk / hazard reduction, however benefits derived from implementing the option that *enable* progress towards the Site End State should be considered here.

The purpose of determining whether or not we are enabling progress against longer-term objectives is to allow a much broader discussion than would occur if attention were focussed exclusively on short-term impacts and risk / hazard reduction. Clean-up of land contamination and partial site de-designation, or demolition of buildings (even if they are of low hazard) may demonstrate progress and promote good community relations. In turn, this approach reflects the need to maintain a balanced approach in prioritising actions across sites.

When setting priorities between competing programmes or investment decisions in different sites, a balanced approach needs to be adopted. Having the Value Framework enables comparison of programmes/projects across the estate irrespective of site (e.g. LLWR, Sellafield) or source (e.g. NDA, PBO). Reduction of high risks and hazards across the estate is a priority area. However, failure to progress in other areas may increase concerns later on, whether through the need to maintain skills, to prevent deterioration of existing facilities, or loss of reputation if progress towards Interim or Final End States is not evident. A discussion of factors to consider within setting the pace and priority of a range of programmes is presented in Appendix 2. In part, this discussion depends on taking a broader view of site and estate wide concerns and issues.

Taking a broader view

The NDA promotes taking a broader view when performing an options assessment and making decisions. Real-life situations are often complex, with many areas overlapping. Adopting a particular strategy may set a precedent or expectation in other instances. A decision to build and operate a facility may make short-term sense, but may introduce complications later on (e.g. during decommissioning). Taking the broader view also applies when considering constraints. For example, an option can have a positive or negative effect on another programme, or can be negatively or positively affected by another programme.

Whilst there are no hard and fast rules, taking the broader view means considering:

- lifecycle implications;

- implications for other programmes, sites and strategies;
- learning from experience;
- demonstrating leadership.

Taking the broader view requires a balanced approach both within and across sites. For example, decommissioning one building early in the programme may facilitate learning and processes that can be implemented to decommission other buildings. Another example would be the construction of a store for ILW that may reduce risk but does not reduce the hazard, and will lead to an extra building to decommission once the ILW has been disposed.

2.2 Implementability

When assessing a range of options, it is important to consider whether an option is implementable. This does not mean that it *will* be implemented, only that it *could* be implemented if identified as the preferred option.

Implementability is influenced by a range of considerations and influences (see Figure 2 and Table 8 in the Appendix). The implementability of an option may change with time as new technologies become available, the workforce develops, or funding changes. There will often be uncertainty surrounding the implementability of an option, so the *degree of confidence* in the ability to implement an option will form a key part of an options assessment (see Section 3.3).

This assessment of confidence may be undertaken by considering the effect that constraints have on that option. For example, in some cases constraints such as time, finances and availability of suitably qualified and experience personnel will be absolute, and in others these constraints will be conditional (see Section 3.2). Furthermore, a conditional constraint (such as time) for one study may be an absolute constraint for another study, and vice versa.

When a number of programmes and projects compete for resources, the *pace* of implementation of an option may be affected, but this will not determine the *priority* of the options (see Appendix 2). Indeed, if an option is planned for a time in the future, provision can be made to ensure skills and resource availability.

2.3 Taking the lifecycle view

The Value Framework emphasises the necessity to consider the full ramifications of implementing any option both at the present time and in the future.

It is not possible (or desirable) to list all factors that may be of relevance to cover all potential assessment situations. Consequently, individual assessments should address broader considerations appropriate and proportionate to the context. Thus, the full lifecycle implications of an option should be considered, including the impact of doing the work and the impact of the work having been done. This approach has been made explicit under the Tier 1 factors, where 'Health and Safety' represents risks associated with doing the work, and 'Risk/Hazard reduction' relates to benefits arising from averted risks after the option has been implemented. However, we advocate this lifecycle view in all areas of the assessment. For example, the environmental impact of doing remediation (such as energy use, disrupting

existing habitats) should be considered against the environmental impact of the completed decommissioning project (land released for future use or to nature, other habitats not impacted by future development).

Lifecycle impacts also include any indirect impacts arising from associated supply chain activities. Simply moving the impact offsite to an alternative location does not remove the impact. The lifecycle view also represents an opportunity to consider wider issues such as intergenerational equity and impacts from anthropogenic climate change.

In line with long-term strategic thinking, the options assessment process should be applied to **consider decisions that will need to be made in the future**, and make arrangements to ensure that necessary information to support a future decision is available (e.g. recognition of a *future* decision-making requirement may be used to initiate an information gathering programme, including R&D, *now*).

3.0 Assessing Options

This section describes the process by which the Value Framework is used to assess options.

3.1 When should the Value Framework be applied?

The Value Framework provides a systematic and transparent tool kit that can be applied whenever it brings value to the decision-making process⁵, such as during the development of Business cases [2], strategy [20] or priorities (See Appendix 2). Situations may include, but are not limited to:

- ◆ the development of strategies to support continued operation of a facility;
- ◆ the development of strategies associated with site or facility decommissioning;
- ◆ the development of new facilities or practices;
- ◆ modification of existing practices.

The Value Framework enables a structured discussion with a clear line of sight between any activity (programme, investment, maintenance, operations or projects) and the NDA's overall strategic objectives.

It is important that the type of assessment being undertaken, and the relevant context, is made clear. For example, options may address:

- “what is to be done” – these are likely to be strategic issues and require a clear overview of long-term objectives;

⁵ It is stressed that the Value Framework does not provide a mandatory list of factors that must always be considered. Proportionality of approach is a key consideration and the Value Framework is intended primarily for significant issues.

- “how something is done” – these are likely to be more operational issues and the assessment will need to demonstrate how objectives are being met (e.g. optimisation, application of ALARA principle and BAT).

The Value Framework can be applied in both cases, because it is sufficiently flexible to allow for differences in the factors and levels of detail to be considered.

3.2 Screening

The first part of any assessment process is to identify all potential options. Once this list of all options has been identified, an initial high-level screening should be applied to remove non-viable options, and thus produce a shorter list of options that can credibly satisfy the objective.

Relevant screening criteria, such as those shown in the Implementability tier of Figure 2, may include consideration of the following key questions:

- Is the option legal? (Note that challenges to regulatory frameworks may be permissible in some cases).
- Does the option comply with national/international obligations? (An indicative list of the type of requirements that may be considered is appended).
- Is the option available within the required timescale? (Again, timescales may be challenged.)
- Does the option meet the objective? (Note that options may be combined).

Pre-judging the outcome of the options assessment, where the Value Framework is applied, should not form part of the screening process. An option may be considered clearly sub-optimal (i.e. alternative options are available which achieve the same endpoint and which have readily identifiable benefits) dependent on the assumptions and constraints underpinning the study. Screening is intended to rule out non-viable options, not to restrict evaluation of credible options, therefore sub-optimal options should be retained at the screening stage. An important part of the screening process is to understand the robustness of your assumptions and constraints.

Knowledge of the assumptions and constraints is essential to an options assessment. An ideal solution is often not possible and it is necessary to balance the ideal with the attainable. Understanding the barriers to these ideal solutions promotes good decisions in two ways. First, this understanding enables options to be reconsidered if these barriers are overcome. Indeed, early consideration of constraints may mean they can be removed by regulators, policy makers or managers. Second, identifying the barriers enables greater transparency when explaining how decisions have been reached.

In many cases, decisions will be constrained by one or more factors.

What is a Constraint?

Constraints act to limit the options that can be implemented. For example, a promising technology may be undergoing trials at a laboratory, potentially offering a faster, more efficient or more cost-effective option than is currently available. However, site or strategic requirements may require that an action be implemented before the new technology is available. In this case, time constrains the approaches that can be implemented. However, all options would be listed at the options-identification stage, including the potential new technology.

If, in this example, the time for implementation is considered to be a fixed factor, it can be said to be an **absolute constraint** and can be used to screen the long-list of options.

If the time constraint can be eased, for example through a planned re-prioritisation of events, options could be reassessed. In this case, it would form a **conditional constraint** and the factors that could amend the assessment would require clear identification.

In all cases, it is important that constraints are identified, explained and documented, and that any dependencies or circumstances that may modify the constraints are noted.

It is the implementation of the option that is constrained, not the identification of options.

Constraints play a key role in options assessment and decision-making. Identification of absolute constraints, in particular, can be crucial as these will block options beyond the long-list stage. A mistake, or failure to understand when a constraint can be challenged, can potentially lead to viable options being discounted. This consideration is discussed further with respect to decision-making in Section 4.3.1.

Some constraints may be specific to an individual site (e.g. size of footprint available) and some may be strategic (e.g. timescales or precursor activities). Equally, some constraints may be regarded as 'absolute', whereas others may be regarded as 'conditional' constraints. Absolute constraints can be used as screening criteria because options that do not meet these constraints are considered unfeasible. In contrast, conditional constraints may present significant challenges to implementation, but may be subject to modification as the decision-making process develops (for example, as further information becomes available). In theory, any factor may form an absolute or conditional constraint. Further, a factor used as an absolute constraint in one study to screen out options may only be a conditional constraint in another study, and may not be a constraint at all in a third study.

Importantly, a factor used as an absolute constraint to screen out options should not be used identically as a factor in the evaluation of options. Once an option is identified as viable with respect to a screening criteria, this criteria should have no further impact on the options assessment. (However, the same factor may be used as both an absolute constraint and a conditional constraint in some situations. For example, cost or dose may be used to screen out options which exceed a cost or dose limit, but cost or dose below this limit may still be a relevant factor in the options assessment.)

Determining what forms a constraint, and distinguishing between absolute and conditional constraints, can be challenging. Compliance with regulatory requirements is often viewed as

a universal absolute constraint. In reality, regulations may not constrain selection of any option; or it may be possible to engage with the regulator to adjust or remove the constraint (i.e. the regulation becomes a conditional constraint) or it may be a non-negotiable barrier to one or more potential approaches (i.e. the regulation is an absolute constraint). Conditional constraints may often be open to 'negotiation' as part of the options assessment process. For example, an increased dose to a worker may be worthwhile (within limits) if there is a significant reduction in the overall risk a facility presents after an option is implemented, or if there is an increased certainty in the implementation of the option.

Likewise, it is often indicated that affordability should not be identified as a constraint, particularly where clear and significant safety issues are involved. However, in many circumstances affordability is a key constraint in determining prioritisation of competing actions.

In some circumstances, undertaking an assessment assuming that there are no constraints may be useful, in order to identify the 'ideal-world' option and to understand how the constraints restrict the implementation of options within the 'real world'.

3.3 Confidence in option implementability

Application of the Value Framework is not a simple flow process model, rather it requires you to consider the details and reality of the problem at all times, and the objectives that you are trying to achieve (and hence the implementability of each option). In turn, this approach requires an understanding of the degree of confidence required in the option. What are the consequences if the option does not deliver the anticipated outcome and does the risk outweigh the benefits?

This assessment of the benefits and detriment of each option should naturally come from the options assessment, but in some cases the degree of confidence associated with implementing an option will be a key concern in identifying the preferred option. For example, there will be a high importance that the selected option performs as anticipated when decommissioning high risk / high hazard facilities because the consequences arising from failure may be serious. Thus, there may be a strong driver to use a more robust, but perhaps less efficient or more costly option, over a developing technology that offers potentially significant advantages but where there is no track record of its application in the context under consideration.

In this analysis of confidence, the risk or hazard profile associated with the implementation of an option should be considered. This profile should consider the relative change in risk and hazard against time, facility, activity or inventory, where risk should account for all on-site and off-site consequences. The initial risk or hazard, and the change in risk or hazard over time, is a key factor in determining priority. Indeed, an option may be constrained by the level of risk accepted in pursuit of value or strategic objectives, in other words: the risk appetite. In such a case, consideration should be given to the benefits if an option is successfully implemented, but also to the consequences if something goes wrong during implementation. These benefits and detriment should be weighted by their likelihood to determine the confidence in implementation of an option.

Implementability can be considered as a series of challenges that should be mounted before a preferred option is identified. Assessing the confidence that an option could be implemented may not be a simple pass/fail test, but an indication of the number and severity of the challenges faced in implementing an option. If time, cost, resources and technical readiness are all marginal, there must be a lower confidence in implementability than for an option that has been used elsewhere and where budgetary control and availability within the timescale are all demonstrable.

3.4 Managing uncertainty

Any assessment of options is likely to include, and require allowance for, some uncertainties. Indeed, there are two principle uncertainties in any options assessment. First, there will be uncertainty around the issue under definition, for example, the nature and extent of contamination. Second, there will be uncertainty around the implementation of an option, for example, availability of skilled staff or the technological readiness of an option (for which the Technical Readiness Assessment (TRA) and Technical Readiness Level may provide useful guides).

In both cases, uncertainty can arise from a lack of knowledge, incomplete information or from inherent variability within a system. Clearly, uncertainty due to information gaps can be resolved, if necessary, by implementing a programme to obtain further information. Nonetheless, information may remain incomplete or reflect real variability. In this case, if appropriate to the assessment case, assumptions can be made to manage the uncertainty. This provides a baseline that can be tested or amended at a later stage.

Identifying, justifying and documenting assumptions is an important component of the evidence-based approach to options assessment. Some typical assumptions are:

- waste disposal sites will be available;
- permits for a disposal or process will be granted;
- regulatory regimes will remain constant;
- necessary related site works will be completed to plan;
- the issue being assessed remains constant (e.g. rate of waste volume generated);
- finance projections remain valid;
- key resources and skills will be available as required.

For longer term projects, assumptions may be modified as knowledge develops, and assessments must reflect this. In many cases, this modification of the assumptions will be related to the reduction of uncertainty

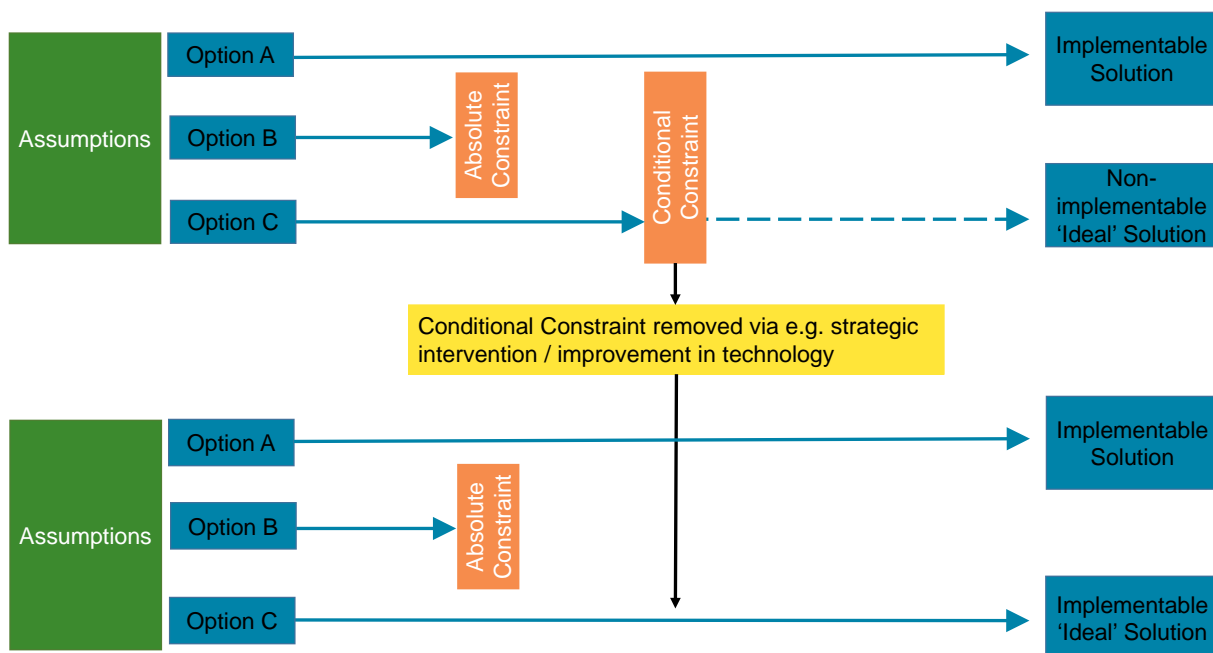
What is an Assumption?

Assumptions help to manage uncertainties that have a **significant bearing** on the options assessment. Assumptions are a way of managing uncertainty or error by fixing a variable to allow an option to be assessed and planning to continue beyond that point. For example, wastes generated as a result of a process may require disposal to a specialist facility, and national policy may make it appropriate to assume that such a facility is (or will remain) available. Alternatively, the extent of contamination within an area may be unknown, so assumptions may be made that the level of contamination is similar to another facility to allow for dose rates to workers to be calculated.

It is important that assumptions are realistic and are not left to chance. Thus, if it is assumed that Suitably Qualified and Experienced Persons are available, training programmes, re-prioritisation of other projects or other measures to retain or release appropriate skills may be required. These actions would, in turn, form a necessary adjunct to identifying a preferred option.

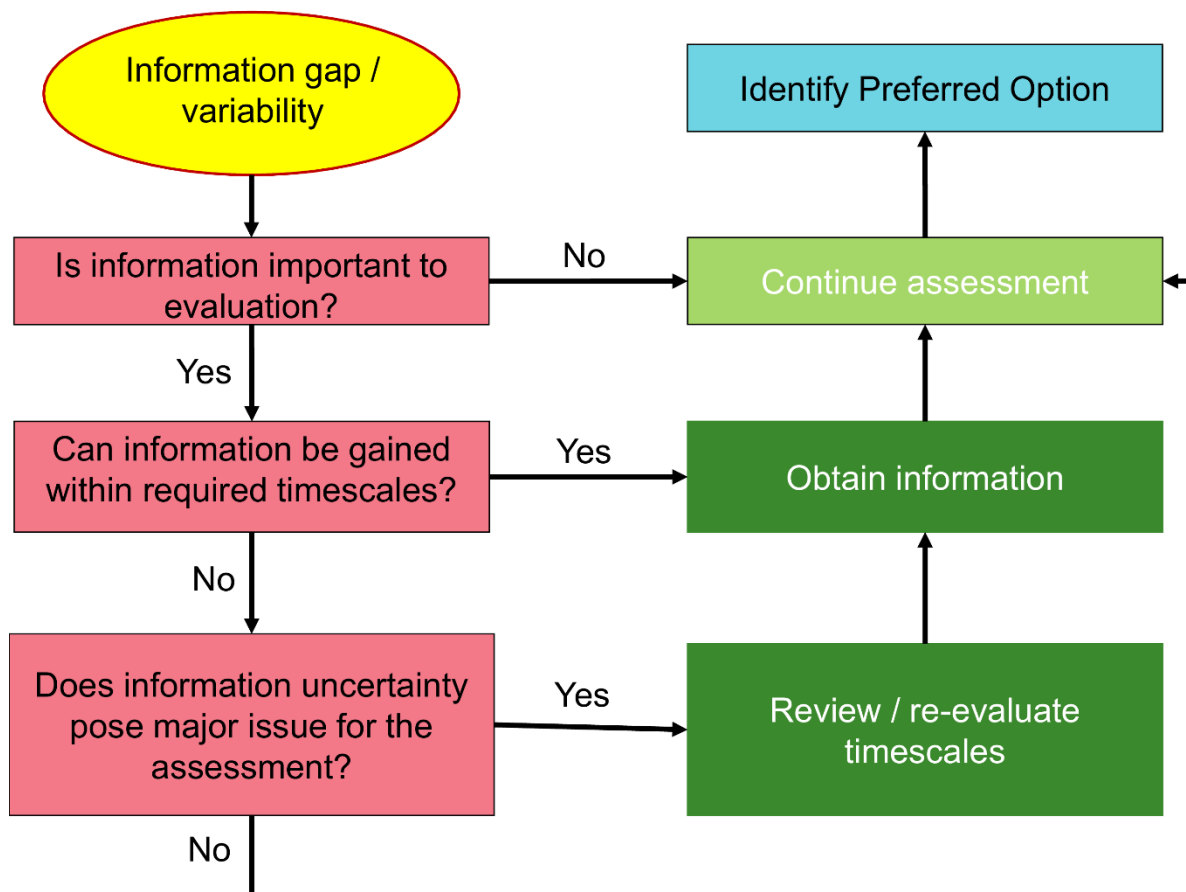
At the risk of over-labouring the point, it is very important to understand how assumptions and constraints act upon options assessment (Figure 3). It can be seen that assumptions are common to all options. An absolute constraint is identified which screens option B out of further assessment. Option C is considered to be the ‘ideal’ way forward but is subject to a conditional constraint, leaving Option A as the selected way forward. However, if the conditional constraint can be challenged or removed, Option C can be implemented. If, on the other hand, the conditional constraint is misidentified as an absolute constraint, Option C will never be assessed as it will be screened out.

Figure 3: Illustrating Constraints and Assumptions



To manage uncertainty, significant data gaps should be identified and recorded, and the assessment process should clarify how uncertainties have been addressed. Understanding how tolerable your options assessment is to uncertainty is important. In some cases, information gaps may not affect the broad study conclusions. In other cases, additional information may be obtained in parallel with the options assessment. In the extreme and after application of the *precautionary principle*, decision-making may be deferred until further work has been undertaken to resolve gaps in knowledge, information or understanding of a system. A guide to addressing uncertainty is provided below.

Figure 4: Guide to addressing uncertainty



Modified from the Nuclear Industry Code of Practice on BAT [5].

3.5 Risk and opportunities

In many circumstances, options under consideration may offer disadvantages as well as advantages, and there may be risks that the option will not deliver as expected. At each stage in an assessment risks should be identified, to reduce potential disadvantages or risks of failure, whilst at the same time seeking to maximise advantages particularly where there are opportunities to enhance the performance of the option under consideration.

3.6 Assessment approach

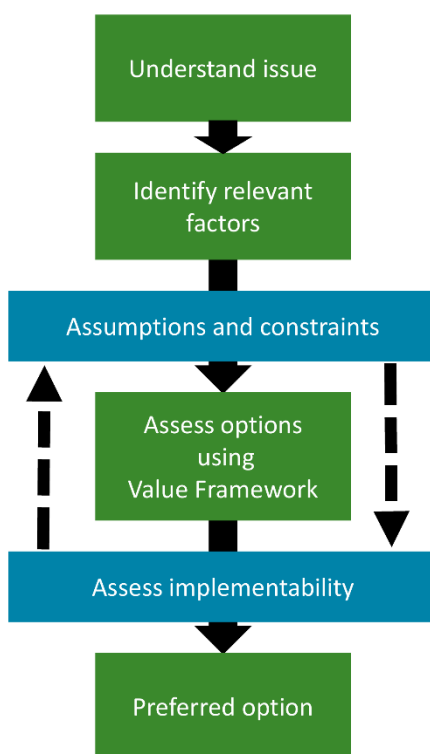
An options assessment should be proportionate to the situation. Where a previous appraisal has been undertaken, or good practice established, use it. This approach emphasises the need for good communication of assessment outcomes (Section 3.7 and Section 4.5), and a streamlined approach to decision-making. It also emphasises the need to think about the purpose of the assessment. Re-writing of a Business Case to provide a BAT statement can be avoided by considering both needs in advance.

Provided that good practice guidance is recent and applicable, this guidance should be used. There is no need to do the same work twice. Use of existing guidance requires only that it is supported in a way that is reasoned, logical and transparent, and with sufficient information to allow an independent review to be undertaken.

Sometimes, a more complex assessment may be required. In this case, multi-criteria analysis may provide a useful tool. General approaches to multi-criteria analysis are provided in HM Treasury's supplementary guidance to the Green Book "*Multi-criteria analysis: a manual*" [21] and the Nuclear Industry Code of Practice on BAT [5]. More specific guidance on the integration of monetary and non-monetary evidence in relation to social impacts has been published by Defra [13]. This guidance does not lay down the assessment approach to be adopted but does require that the assessment approach be justified and form part of the study documentation (see Section 3.7).

As in Section 3.3, we note that application of the Value Framework is not a simple flow process model, rather it requires you to consider the details and reality of the problem at all times and the objectives that you are trying to achieve. The application of the Value Framework is illustrated in Figure 5.

Figure 5. How to assess options with the Value Framework



Comparing Options

All relevant factors should be assessed independently for each option. Independent assessment of factors requires that other factors to be used in an assessment are known and understood, and any interactions between these factors are clearly considered (for example, through clearly defined assumptions). Thus, one option does not always have to be identified as 'better' or 'worse' relative to another option. Some options will perform equally well against one or more factors, whereas some factors may introduce clear distinction between the options being considered. Factors that do not distinguish between options can be omitted from more detailed consideration.

An assessment may need to reflect the priority accorded to one or more factors under discussion, or may need to address differing opinions or priorities. Where a numerical approach has been adopted this prioritisation can be accommodated through weighting factors, with appropriate statistical interpretation. Any weighting factors used should be explained and justified. Where a discussion based approach has been adopted, a record of non-reconcilable views should be maintained and comment made on whether this would alter the outcome of the overall assessment.

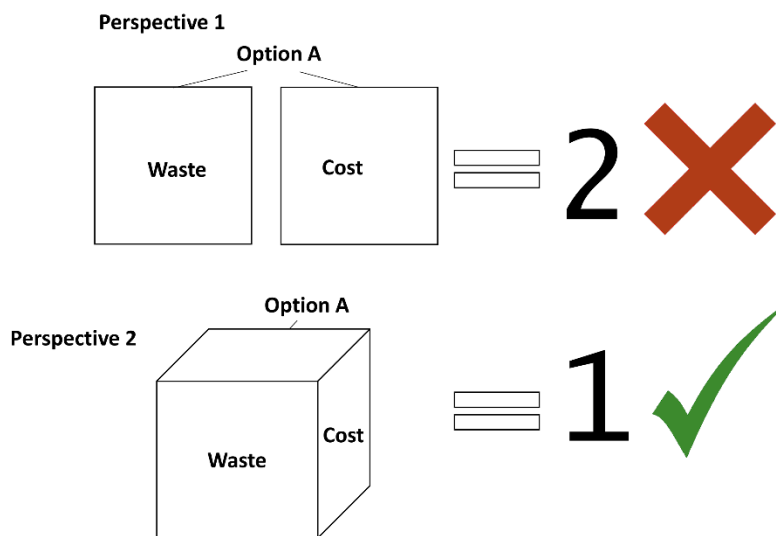
3.6.1 Double-counting

Consideration should also be given to the potential for ‘double-counting’ of the positive or negative impacts of options. For example, the increased security arrangements or potential concerns associated with the storage or transport of higher level wastes or materials may be double-counted with increased costs.

There may be occasions when such double-counting is considered to be appropriate. In this case, it should be acknowledged and recorded within the study documentation. Wherever practicable, however, double-counting should be avoided when assessing options. Double-counting can be avoided by a clear definition of assumptions and uncertainty.

Conversely, sometimes one factor may have multiple effects. A strategic objective may have consequences for timescales, costs, or remediation measures to meet the relevant site end state. All of these factors require consideration when assessing the options.

Figure 6: Avoidance of ‘double-counting’



The principle of avoiding double-counting can also be applied to avoidance of duplication of effort. As previously mentioned, where established good practice or a similar options assessment exists, these should be used.

3.6.2 Comparing properties that are hard to measure

Balancing benefits and detriments may require the comparison of dissimilar properties. Particular difficulties often arise with:

- providing an objective measure for benefits or detriments associated with environmental damage;
- identifying indirect benefits, such as avoidance of potential accident consequences;
- consideration of societal expectations;

- impacts that potentially span long time periods.

There are no hard and fast rules. Some established principles may give guidance, such as maintaining intergenerational equity. However, in general, the approach is to **establish which issues are considered to be of greatest relevance** in an 'ideal world', and which are most constrained by practical considerations, before making a balanced decision.

3.6.3 Guiding principles

In addition to the more formal criteria identified above, a number of guiding principles should be taken into account, such as application of the waste hierarchy or adopting a precautionary approach. Such principles are not prescriptive but may form part of the basis for discussion. A number of widely recognised guiding principles that may be considered are given in Appendix 3. In addition, the following should be considered throughout the discussions undertaken as part of the options assessment.

Completeness of Information. All options should be assessed against a comparable level of information. Such information should be as comprehensive as possible. This is not always possible, particularly at the early stages of a study, and care should be exercised to ensure that uneven collation of information does not lead to bias.

Avoid giving a false impression of accuracy. Information is often incomplete or conditional upon a range of assumptions or other workstreams. It is important that the level of information available is reflected within an options assessment.

Robustness. It should be recognised that requirements may be amended. The degree to which options are flexible in application, and potentially transferable to other contexts, should be indicated when presenting a preferred option.

Quality Assurance. Is a system in place to catch mistakes and errors?

Timeliness. Ideally, options should be assessed and preferred options implemented at the time that offers the biggest impact (for example, in terms of environmental performance/impact, value for money, waste form disposability or hazard reduction). In practice, the timing may be dictated by many factors, especially where a change to an existing process is being considered. Nonetheless, the timeliness of a project should be considered as a principle to enable early comparisons to be made between potentially competing requirements for funding.

Rationality. Any process of identifying a preferred option from an array of alternatives can be open to challenge. Consistency in the approach to an assessment will reduce potential challenges arising from subjective bias (including 'optimism bias'; see Section 3.7). Nonetheless, once a preferred option has been identified it should be tested against prior expectations, if any. A wholly unexpected outcome may be valid, but it could indicate that key information requires confirmation.

3.7 Documentation approval

An integral part of options assessment is to ensure that it is properly recorded and **documented**. This documentation should present the information base and the judgements concerning the relevant factors in order to facilitate learning from experience.

HM Treasury's Green Book [4] and supplementary guidance [22] notes that 'optimism bias' can arise in relation to costing and programming – but in principle this bias can arise within any set of assumptions and learning from experience can help to reduce such unintentional bias in future assessments.

The outcome of an options assessment is a preferred option. This preferred option will have been identified from a list of all viable options. However, before an option can be implemented, it will need approval, even if it is the best option to solve the problem. This requires that a Business Case is submitted, demonstrating the benefits of implementation.

4.0 Decision-making

It is not the purpose of this document to describe the decision-making process, however a few general points are made in this section.

4.1 Identifying the decision-maker

Ultimately, most decisions are made by an individual who has the authority, and carries the responsibility, to determine the course of action.

Prior to any assessment that will require a final decision, the relevant decision-maker (Single Point of Accountability) must be identified and should be involved in (or at least aware of, and approve) the options assessment being undertaken. The decision-maker must also ensure that the rationale for their decision is recorded with reference to the relevant factors (see Section 4.5).

4.2 The role of the Value Framework

The Value Framework, and the evidence base presented as part of the options assessment, is an important input to the decision-making process, regarding the implementation of one or other proposed way forward. Nonetheless, **a study leading to the identification of a preferred option should not be regarded as making the final decision**. The final decision rests with the identified decision-maker.

Decisions should be considered collectively in an integrated and prioritised approach. As such, sufficient time should be allowed within the decision-making process to allow for the proportionate application of the Value Framework. Early consideration of key environmental decisions enables removal of constraints and allows benefits from opportunities to be realised.

4.3 Review prior to implementation

Decision-making is often a staged process with a narrowing of options at each stage, rather than a single step from issue definition to option implementation. Subsequent to the identification of a preferred option, and ahead of a decision to implement one or other specific approach, more detailed studies may be required or recommended regarding any aspect of the assessment (for instance: technical performance, cost, impacts associated with implementation or other factors).

At this stage, the implementability of the option is also assessed, as per the management case, commercial case and financial case [2]. In most situations, some issues concerning the practicality of implementation will have been considered within the Value Framework discussions, together with consideration of lifecycle impacts and implications for enabling the mission. Nonetheless, all studies are to some extent limited in the scope they can cover. Consequently, the review prior to decision-making will consider affordability and potential competing demands with respect to setting priorities and timescales on actions (see Appendix 2).

4.3.1 Understanding the impact of constraints and assumptions

Within the options assessment, a number of factors may constrain the range of options that are considered practicable. Conversely, assumptions may be required to underpin the practicability of implementing one or other option.

Understanding the nature and implications of both constraints and assumptions is vital, both to the Value Framework assessment of options and the decision-maker (see Section 3.2). Where a constraint is considered to be absolute it may have been used to screen out options entirely from further consideration. At the stage of reviewing the preferred option it is too late to rectify a false constraint without reconsidering the entire assessment. Consequently, **if you believe that the constraints are open to challenge then don't constrain the options but rather understand the impact of the constraint on the options so it is clear which constraints are worth challenging and why.** This approach enables the decision-maker to evaluate the best possible options accounting for constraints.

False assumptions may be less damaging, as they will not limit the options put forward but may lead to an assessment identifying a preferred option that cannot be implemented in practice. Therefore, all assumptions must also be subject to review before a final decision is made.

4.4 Available guidance

Guidance on decision-making within the NDA is described in the Strategic Management System [23], the expectations for Business Cases and Value Management [2] and financial sanctioning [24]. We note that even if a preferred option is supported by a solid Business Case it may not be implemented because of competing demands at a higher-level of the organisation. In particular, funding for the NDA comes from government. NDA competes for

these funds with other national institutions and projects (for example, the NHS, High Speed 2, and education)

Risk management forms a reasonable consideration within the decision-making process. For example, loss of public confidence due to an avoidable accident situation is likely to outweigh financial costs or savings from an initial decision or from later recovery operations. HM Treasury's Green Book [4] offers guidance on risk management and application of the precautionary principle (see also Appendix 4). The confidence in the preferred option may also be a relevant factor when decision-making. Depending on the risk appetite of the decision-maker, an option may be chosen that is not the identified preferred option because of confidence in the ability to implement the option (see Section 3.3).

4.5 Documenting the decision

It is important that the whole decision-making process is documented. In addition to a documentation of the options assessment, the decisions arising after the options assessment should also be recorded. In practice, both the options assessment and the decision may be recorded in the same document.

This documentation should describe both *how* the decision was made (e.g. the judgement on alternative ways forward) and *why* the decision was made *in context*. This documentation will ensure that decisions made can be reviewed and understood many years into the future, when authors of the original assessment are no longer available. In particular, documenting the decision will facilitate learning from experience. For example, in the long-term, did decisions prove to be robust or could foreseeable improvements have been introduced?

5.0 Implementation and Performance Review

Before an option is implemented, it will be reviewed as part of the Business Case. However, even if an option is supported by a strong Business Case it may not come to fruition because of competition for funding at the national level (e.g. for transport or healthcare).

Assuming that the preferred option is implemented, a review of performance enables a check to be made that the strategic tolerances or performance indicators associated with the implementation of an option are being met (i.e. to answer the question, is the original objective being met satisfactorily?). Likewise, a performance review ensures that any potential detriments associated with the implementation of an option have been managed.

Recommending the requirement for, or intervals to undertake, a performance review of the preferred option does not form part of the Value Framework. However, this document may offer useful information to the decision-maker on this subject. Typically, where the implementation of an option may take some years, or where a long-term strategic objective is set, reviews may form part of a scheduled programme. For example, the assessment and decision may be reviewed formally every 2 to 5 years as appropriate.

Other triggers for the review of an assessment may also be relevant, and the general rule of thumb must be that any assessment or decision with long-term implications must be reviewed

whenever circumstances indicate that a key factor may have changed. Illustrative triggers for review may include:

- competing options (e.g. for funding) are assigned a higher priority;
- previous assumptions or key constraints no longer apply, for example:
 - significant new information becomes available;
 - new techniques become available, or techniques previously identified with a low technological readiness are implemented elsewhere;
 - regulatory guidance or statutory obligations are amended.

Review Does Not Always Mean Change

The requirement for review does not necessarily imply that the previous assessment will be modified. To take one example, the availability of new techniques, even if they offer improved performance, does not mean that an existing programme should be modified. A technique or approach that may be optimal for a new application will not always represent the optimal approach when applied retrospectively. Modification of existing processes should be assessed against the same Value Framework as applied for new processes.

The purpose of a review is to determine whether a previous assessment or decision requires modification, it does not pre-judge that modification is always required.

6.0 The Role of Stakeholders

The Value Framework offers guidance on factors to be considered within an options assessment. The contributors to the assessment are not prescribed. Nonetheless, it is noted that the Nuclear Industry Code of Practice on BAT [5] states that:

“Stakeholder input can be helpful to good decision-making and time for stakeholder engagement should be factored into the schedule, where appropriate. Stakeholders may include internal users, operators of adjacent facilities and programme facilitators. External stakeholders may include regulators, contractors, designers and other suppliers as well as local groups. The definition of stakeholders is broad and it is apparent that their inclusion in a study can add value through inputting to screening criteria and drawing the attention of decision-makers to wider considerations.”

These comments may also be applied to the assessment process and the inclusion of internal (e.g. NDA) and external stakeholders, in addition to technical experts, should be considered when identifying the relevant assessment panel. In general, wider stakeholder engagement is encouraged. Nonetheless, it is recognised that input to a programme of work entails time and effort. This should be borne in mind when inviting participation so as to get the balance right. For a simple technical study, minimal external stakeholder engagement may be required. However, where less tangible factors are involved, or more complex and strategic issues considered, there is likely to be greater benefit from broad consultation.

7.0 Summary and Conclusions

The Value Framework has an established record in promoting cost-effective risk and hazard reduction across the NDA estate, through its application to establishing Business Cases [2]. The detail of the Value Framework has been developed further, to make explicit the alignment with Government guidance and the NDA's wider objectives and business processes, for use across a broad range of strategic and investment applications.

The Value Framework does not reduce the ability of stakeholders to input to assessments. Rather, the Value Framework provides a logical structure around which alternative options can be discussed, enabling a clear alignment between assessment of any activity (programme, investment, maintenance, operations or projects) and the NDA's overall strategic objectives.

8.0 References

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Appendix 1. Value Framework Tiered Criteria

This appendix lists factors that may be considered as part of an assessment. Not all factors will always be relevant. An early part of an assessment is to determine which, if any, factors are not applicable (with justification) and which factors are most important in context. **Factors that overlap with the Strategic Environmental Assessment (SEA) are indicated in green, those that overlap with the Health Impact Assessment (HIA) are indicated in blue, and those that overlap with the Socio-economic Assessment are indicated in red (SeA).**

Table 1: Factors Relating to Health and Safety

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Worker Health — Radiological	Individual dose or risk	Based on upper individual dose estimates (i.e. NOT averaged over the workforce or a sub-section of the workforce).	Not demonstrated to be ALARA.	Demonstrate use of optimisation to reduce dose / risk.			
	Collective dose or risk	Consider the total dose forecast for the workforce over the lifetime of the project (both project workers and nearby facilities).	Reducing individual dose increases collective dose	Demonstrate use of optimisation to reduce dose / risk.			
Worker Health — non-radiological	Risk from controlled substances (COSHH)	Based on upper individual risk estimates (i.e. NOT averaged over the workforce or a sub-section of the workforce).	Exposure not demonstrated to be adequately controlled.	Exposure prevented.			
	Construction / Operational impacts	Construction risks include fall from height, slips & trips, etc. Operational risks refer to 'work-related' type risks.	Use of visual equipment, stress, repetitive strain injuries, fire, manual handling	Work with supply chain to ensure safe working practices.			
Public Health — Radiological	Individual dose or risk	Based on upper individual (critical group or representative person) dose estimates. Here we consider discharges. Residual contamination is considered under risk/hazard reduction.	Not demonstrated to be ALARA.	Demonstrate use of optimisation to reduce dose / risk.			
	Collective dose or risk	Relevant for long projects. Typically measured as the collective dose to the UK & European populations, truncated to 500 years integration time.	Very small doses over long timescales may be over-estimated.	Identify spatial and temporal dose distribution.			

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Public Health — non-radiological	Risk from discharged substances	Based on upper individual risk estimates. This includes the risk to the public from solid, liquid and aerial discharges.	Not demonstrated to be ALARA.	Change form or reduce quantity discharged.			
	Transport	Transport may, on occasion, be included within the 'nuisance' factors where it impacts on perceptions of noise and emissions etc. However, transport miles more readily equate to risk of accident and consequences to persons affected.	Transport miles need to account for the return element of journeys unless there is a clear and separate purpose for the return journey.	Use of lower risk modes of transport (e.g. rail or sea freight). Reduce number of journeys through optimal loading. Avoid unnecessary journeys.			
Nuisance	Noise Odour Visual impact Vibrations Dust	dB/hedonic scores/concentrations of chemicals/volume of dust produced, etc. The intent is to address <i>perceived nuisance</i> rather than simple scores of amounts. Consideration of architecture and the visual impact on the landscape may be a factor.	Nuisance is subjective and hard to assess. Unsightly buildings. Transport may be double-counted under Security or Public Non-rad. Visual impact may be double-counted with dust. Dust may be double-counted with non-rad discharges.	Reduction of noise through barrier methods. Change in time of noisy activities. Reduction of vibrations through change in techniques applied. Reduction of dust through water or on-tool extraction. Improvement in landscape or ambience through good architecture/design.			

Table 2: Factors Relating to Security

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Management of waste/materials	Transport of highly radioactive wastes or materials beyond the site	Need to ensure this is not just another way of assessing transport miles. The purpose is to consider <i>security of the waste or material</i> , rather than risk to persons.	Security may be compromised where extensive transport is required (e.g. due to terrorist threats).	Use of on-site or local facilities (also consistent with <i>proximity principle</i>).			

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
	Involves a change and impact to security arrangements	Identify security protocols and requirements to change operational procedures.	Material spread across several sites reduces risk from single event.	Material present on single site concentrates security.			
	Creation, use or storage of spent nuclear fuel, separated Pu/U, enriched U, high level sources etc.	The issue here is security. The impact from discharges and disposals is considered within Health and Safety.	Stockpiling of materials that have no asset value but represent a potential risk from terrorist interest.	Can material re-enter the fuel cycle.			
Information Security (Sensitive Nuclear Information)	Storage	Consider the conflict between security of information and ease of access for legitimate use of information. What storage or back-up arrangements are in place (e.g. use of the 'cloud', transmission by on-line e-mail)? Consider the longevity of information (e.g. the time at risk).	Risk of information loss if not backed-up. Potential risk that information may be accessed (e.g. 'hacking') if security insufficient. Double-counting with Format considerations.	Consider encryption methods, firewalls, offline networks, password-protection, etc.			
	Format	Hard copy vs electronic information. Requirement for safes, keys, codes, briefcases. Effort required to introduce new security protocols (i.e. of higher security marking). Consider the required longevity of information (e.g. the time at risk).	Hard copy may offer greater short term security but can be lost. Electronic information offers ease of access but can be harder to secure.	Secure encryption devices for electronic information. Use of fireproof safes, etc for hard copy information. Ensure that information requires security classification.			

Table 3: Factors Relating to the Environment

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Process discharges	Radiological Discharges	Liquid or aerial discharges	Counter to 'concentrate and contain' policy. Potential for double-counting with 'Impact on non-human biota' factor under Environment. Note OSPAR commitments	Reduction of discharges through change in process.			
	Solid waste-radiological	Volume and category of waste generated (HLW, ILW, LLW, LA-LLW, VLLW).	Disposability, leachability, heterogeneity, activity concentration, boundary waste, decay storage, requirement for interim storage, and ability to meet existing Waste Acceptance Criteria at treatment/disposal sites. Potential for double-counting with cost. Potential for double-counting with 'Impact on non-human biota' factor under Environment.	Reduce waste category through improved segregation and application of Waste Hierarchy. Consider radiological properties of waste.			
	Non-radiological discharges	Liquid or aerial discharges	Size of entrained particles reduced below detection limit, but number of particles increased. Potential for double-counting with 'Impact on non-human biota' factor under Environment.	Improvement in 'quality' of discharges.			

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
	Solid waste — non-radiological	Volume and category of waste generated (hazardous, non-hazardous, inert)	Requires landfill – least preferred waste management strategy Potential for double-counting with 'Impact on non-human biota' factor under Environment.	Application of Waste Hierarchy.			
Indirect discharges	Grey water / Foul water	e.g. from changing rooms	Cross contamination of effluent outlets.	Reuse grey water for irrigation or heat recovery. Use new toilet technology to improve quality of discharge.			
	Solid wastes	Consider organic wastes (e.g. food waste) and inorganic wastes (e.g. scrap items)	Health hazard (e.g. putrescible wastes)	Use for compost. Can scrap items be reused?			
Materials use	Use of 'minerals' — e.g. metals, concrete etc.	Consider use of raw materials (other than water). Is there potential to avoid export (as waste) and import (of fresh material)?	Inert waste not sufficiently segregated from hazardous waste or asbestos in building materials. Contamination of building fabric is above exemption levels (e.g. due to heterogeneity, even if average activity is below exemption values).	Can plant/items be re-used? Can wastes (e.g. demolition rubble) be recovered for on-site use (e.g. to fill on-site voids / landscaping for interim end state or Final Site Clearance) or off site (e.g. for road building)?			
	Water	Consider both the volume of water and the type of water required.	Effluent water as source of pollution.	Reduce volume or 'grade' of water used (e.g. downgrade from demineralised to drinking water to raw river, lake water to seawater). Use of on-site sources (e.g. rain water).			

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
	Energy	Consider total lifecycle impacts, e.g. short term energy use (construction or production of components); longer term energy use (within process and/or in associated machinery, lights, maintenance etc.). Final decommissioning requirements should also be considered.	Because easily quantified, energy usage used as sole metric for environmental impact.	Use of “clean energy” — renewables and nuclear.			
Impact on non-human biota	Impact on protected or sensitive environments	Identify Natura 2000 Habitat Directive sites (SACs/SPAs) or other SSSIs and areas of local interest or cultural heritage etc.	Only sites with a formal status are considered.	Use of brownfield sites. Habitat creation or maintenance on and off site.			
	Radiological dose rate	Consider both short term and lifecycle impacts. Compare dose to screening values as ‘impact index’. Consider other measures (e.g. biodiversity indices).	Generic screening values are very restrictive. Different biodiversity indices can present misleading impressions	Use of brownfield sites. Environmental improvement (e.g. habitat creation).			
	Non-rad impacts	Short term impacts may include deoxygenated or highly acidic/caustic liquid effluent releases that impact the environment as a ‘one-off’ slug. Long-term impacts include effect of roads or dams on animal migration patterns or habitats.	Potential release of List I and List II restricted substances. Use of virgin land.	Use of brownfield sites. Environmental improvement (e.g. habitat creation).			
Impact on ‘climate change’	Emission of greenhouse gases	Greenhouse gases includes methane, carbon dioxide, nitrous oxide, water vapour and ozone.	Double-counted with energy use.	Improvement in ‘quality’ of emissions.			
	Atmospheric chemistry/Aerosols	Effect of emissions on cloud brightening, cloud temperatures, cloud height, and other indirect effects such as impact on ozone.	Only certain size-ranges of emissions or certain processes considered.	Colour/type of roofs can reduce albedo. (e.g. grass roofing).			
Controlled waters impact	Physical impacts	Changes in groundwater flow and height as a result of activities.	Groundwater table reduced by construction.	Remediation of natural watercourses.			
	Contamination	Potential for inadvertent contamination	Breach of Groundwater Directive.	Clean-up of potential source terms.			

Table 4: Factors Relating to Risk and Hazard Reduction

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Radiological risk reduction (workers)	Individual dose or risk averted	Based on upper individual dose estimates after implementation of the option (i.e. NOT averaged over the workforce or a sub-section of the workforce).	Not demonstrated to be ALARA.	Demonstrate use of optimisation to reduce dose / risk.			
	Collective dose or risk averted	Consider the total dose forecast for the workforce after implementation of the option.	Reducing individual dose increases collective dose	Demonstrate use of optimisation to reduce dose / risk.			
Non-radiological risk reduction (workers)	Risk from controlled substances (COSHH)	Based on upper individual risk estimates after implementation of the option (i.e. NOT averaged over the workforce or a sub-section of the workforce).	Exposure not demonstrated to be adequately controlled.	Exposure prevented.			
Radiological risk reduction (public)	Individual dose or risk averted	Based on upper individual (critical group or representative person) dose estimates after implementation of the option. May be due to discharges or residual contamination at the Site End State.	Not demonstrated to be ALARA.	Demonstrate use of optimisation to reduce dose / risk.			
	Collective dose or risk averted	Typically measured as the collective dose to the UK & European populations, truncated to 500 years integration time.	Very small doses over long timescales may be over-estimated.	Identify spatial and temporal dose distribution.			
Non-radiological risk reduction (public)	Risk from residual contamination	A range of contaminants may remain <i>in-situ</i> at the Site End State with chemically or physically hazardous properties.	Chemical spills, oil contamination, asbestos and other hazards may remain on site, associated with soil or with sub-surface structures left <i>in-situ</i> .	Consider all potential contaminants within Site clean-up assessment, including those arising from previous site use (if any).			
Status of inventory	Condition of facilities	Many of the NDA sites contain facilities that were built before modern standards were introduced. Do the options have positive or negative impacts on the condition of older facilities?	Unplanned releases may arise if the integrity of facilities is undermined.	Decommissioning older facilities may reduce overall risks, even if the inventory remains unchanged (i.e. is relocated to more modern/robust facilities).			

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
	Waste condition	Are the wastes in a form that is compatible with the desired final form? For example, are letters of compliance available?	Waste retrieval and handling increases workforce risk of exposure.	Increase reliance on passive safety features.			
	Waste storage	Does the option improve or reduce confidence that wastes can be stored safely until a final disposal route is available?	Extended storage may increase the risk of container failure.	Interim storage may gain benefit from radioactive decay and increase final management or disposal options.			

Table 5: Factors Relating to Socio-Economic Impacts

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Economic impact	Local spend	Contribution to local GDP.	Local spend work contracted out of area.	Different areas (e.g. urban/rural) may benefit more from same spend.			
	Impact on jobs in the community	Consider both short- and long-term employment for current and new workers. Include supply chain. Mental aspects of job loss may be considered (but should not be double-counted with Health and Safety or Risk / Hazard reduction)	Area may become over-reliant on jobs from one sector.	Job stability. Creation of apprenticeships.			
	Housing ('blight'/increase in value)	New housing estates being developed may impact on local value of houses. This may be linked to 'regional perception' with the associated positive or negative reputational aspects arising from projects and programmes.	Undesirable increase or decrease in value. Regional perception is highly subjective and may not be directly linked to the options under consideration.	Desirable increase or decrease in value. Boost to image of SLC/NDA/company.			

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
	Impact on hospitality sector (hotels, B&B, restaurants etc.)	More work-related business from contractors, customers and business partners.	May overload existing facilities.	Generate additional local business spend.			
Impact on infrastructure	Impact on physical infrastructure (transport links etc.)	Improved road, rail, sea, flight. May be negative depending on viewpoint. Long-term benefits derive from self-sufficiency or integration.	Engineering works cause short-term issues out of proportion to potential benefits.	Increased tourism, saved costs to local business.			
	Community facilities	e.g. hospitals, clinics, schools, leisure facilities, shops. This should include the impact on the demographic mix in a community, the balance and capability and capacity to accommodate change. There may be an implied impact on the health or wellbeing of the community.	Overcrowding of existing facilities.	Building of new facilities.			

Table 6: Factors Relating to Finance

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Costs	Capital costs	Consider both discounted and undiscounted costs. Does discounting make sense in this context? When will the spending occur?	Potential exposure to exchange rates in cost of materials.	Remove spikes in expenditure: advance purchase, fixed price agreements etc.			
	Costs of maintenance (revenue spend)	Include costs for keeping the NDA estate safe (e.g. asset management) and compliant with legislative/regulatory requirements.	Exposure to financial penalties if non-compliant with regulatory obligations.	Reduced financial risk to business.			
Return on spend	Direct return	Is there a business opportunity or impact on the value of assets?	Assets (e.g. land) not required in local planning.	Positive impact on the value of assets			
	Release of land for reuse	Use of land for commercial, leisure or agricultural activities.	Perception restricts land use.	Improve environment or business opportunities.			

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
	Reduced costs	How have long-term costs been forecast?	Cost estimates change.	Reduced 'hotel' or maintenance costs.			

Table 7: Factors Relating to 'Enabling the Mission'

Tier 2	Tier 3	Guidance on questions to address	Risk	Opportunities	Relevance to specific assessments		
					SEA	HIA	SeA
Taking the Broader View	Maintain / develop capability.	Consider how actions i) affect capability to undertake other work on a specific site or ii) affect capability to undertake other work across the NDA estate. This may be through testing different approaches or technologies, or skills and knowledge management.	Developing a capability may not be cost-effective (cheaper to buy in skills from elsewhere)	Decommissioning of one building may help with another.			
	Enabling progress towards End State	Does action promote/hinder progress toward site End State (e.g. ILW store may be needed short-term but is then another building to be decommissioned)? Release of resource in one area could enable progress in another.	Action may lead to short-term benefit but long-term detriment towards site end state.	Action could cause significant progress towards Interim or End State.			
	Give clear direction	Does action provide a clear direction for future activities?	Action may be overturned by a future decision.	Chance to demonstrate leadership.			
	Setting precedents	Does the action introduce new technology or provide an opportunity for innovation and progress?	Novel techniques have a higher uncertainty.	Quicker progress than otherwise.			
Reputation	Government policy	Does the action promote or hinder the Government policy with respect to new nuclear build programme?	Loss of confidence in the ability to decommission NDA sites will reduce the likelihood of new build, and may affect non-nuclear activities such as hospitals/universities.	Closing the loop on decommissioning and waste management/disposal will promote confidence in the new nuclear programme.			

Table 8: Implementability

Tier 2	Tier 3	Guidance questions	Notes
Resources	Cost	<p>Is the option within previously agreed budgets?</p> <p>Is more money available and secure?</p> <p>Is the option constrained by a spend profile?</p> <p>Will finance projections remain valid?</p>	<p>Both the total cost and the relative rate of expenditure compared to the anticipated funding available should be considered.</p> <p>Evaluation of affordability requires that all direct and indirect spend is accounted for.</p> <p>Funding is not inexhaustible. Affordability will never determine priority, but may be a key factor in establishing the pace of implementation.</p>
	People	<p>Are enough SQEP available?</p> <p>Can SQEP be imported or developed?</p> <p>Is a quality assurance procedure in place to prevent mistakes and errors?</p> <p>How easy will deployment of the right people to the right place at the right time be?</p> <p>How easily can workforces and teams be developed or remoulded to meet changing requirements?</p>	<p>It is not sufficient that a skill exists, it must be available to implement the programme.</p> <p>Can action be taken to prevent skills shortages?</p>
	Materials and equipment	<p>Is the option constrained by a resource profile?</p> <p>Are enough raw materials available?</p> <p>Is specialist equipment required?</p> <p>Are quality controls and checks in place?</p>	<p>As above, resource availability does not determine priority but may be a key factor in establishing the pace of implementation.</p>
Logistics	Space	<p>Does space or location form a constraint?</p> <p>Will necessary, related site works be completed to plan?</p>	<p>Space may also physically constrain options, and there may be unique constraints that apply to a specific facility, site or area.</p>
	Upstream / downstream facilities	<p>Are waste management routes available?</p> <p>Are assets in suitable condition to implement option?</p> <p>Does the option rely on external facilities or operation?</p> <p>Will waste management routes be flexible enough to cope with changes in volume or type or waste?</p>	<p>It is important that interim measures (e.g. conditioning for storage) do not constrain final waste management options (e.g. disposal or recycling) whilst, at the same time, recognising that final waste management options may not be available and thus making safe in the interim has a higher priority.</p>

Tier 2	Tier 3	Guidance questions	Notes
	Time	Is the timescale for implementation constrained? How long will the option take to implement?	Timescales can be challenged, but may form a constraint on implementation of an option, particularly where there are dependencies between different options assessments, or action needs to be taken immediately.
Technology	Compatibility	Is the option compatible with existing plant and processes? Can the technology be used in more than one area?	Some technology may be highly-specialist, whereas other technology may be multi-purpose and be transferred to other areas around the site. The specific situation will determine if highly-specialist or multi-purpose technology is desirable.
	Availability	Is the technology available? What is the Technical Readiness Level of this technology?	High-urgency programmes may require the use of established technologies, even where emerging technologies may prove, in time, to be more efficient or effective.
Policy and strategy	Compliance with other strategies, policies and principles.	Does the option rely on external facilities or operation? What is the influence of the option on other strategies / programmes? Does the option have a suitable risk/hazard profile? Is the option constrained by regulation or policy? Is the option constrained by stakeholders? Does the option fit with site End State/Date commitments? Can conditional constraints be removed? Are the assumptions justified? What actions are being taken now to ensure assumptions are justified? If using a previous assessment as a guide, have the assumptions changed? Will the issue being assessed remain constant? (e.g. rate of waste volume generated) If using a previous assessment as a guide, have the constraints changed? Would discussion with the regulator be beneficial? Will the regulatory regime remain constant?	Determining the pace and priority of implementing programmes should be based on current requirements unless there are clear indications that national or international policy or controls are subject to change. It is not intended to 'second guess' policy makers.

Tier 2	Tier 3	Guidance questions	Notes
Stakeholder confidence	Confidence in evaluation process and underpinning information.	Do the stakeholders have confidence in the evaluation process and information used in this process? Is implementing the option a good idea? Is there social inertia to the option? Will the option provide confidence in further innovations?	Stakeholder engagement requires understanding of the issues involved and is an important factor in establishing local solutions to regional and national issues.
	Confidence in ability to implement the outcome.	Does the option provide confidence to external stakeholders (including regulators) that the NDA estate is being managed effectively? Can the option be implemented effectively? Will increased stakeholder confidence increase productivity? Or lead to a more flexible regulatory approach?	Confidence in implementability may be improved through engagement of stakeholders in the evaluation process.

Appendix 2. Setting the Pace and Priority for Implementing Programmes

Purpose

The NDA's remit is to deliver timely reduction of risk and hazard across its estate in a safe, secure and cost-effective way while protecting the environment for the present and future generations.

Recognising that we cannot do everything immediately, we need to prioritise our activities. This means that we identify those activities that require more urgent action, while maintaining progress across the estate towards final site End State objectives. At the heart of our Strategy we seek to ensure that we consistently protect people and the environment. Thus, at a high level, we have three priorities:

1. Where risks to people or the environment are *intolerable* we will take urgent action to reduce them.
2. Where the risk is *tolerable* we take greater account of other relevant factors but our focus remains on risk reduction.
3. Where risks are *broadly acceptable*, our attention turns to mission completion in line with our Site Interim and End State objectives.

These priorities will drive the allocation of resources but it is always necessary to maintain a balance. Risk reduction at one site must not be at the cost of a disproportionate increase in risk elsewhere. Wherever practicable, short term risk reduction should not cause longer term obstacles to achieving site End State objectives. Site decommissioning and remediation requires a phased approach involving both construction and decommissioning of facilities.

Assessing options within individual initiatives or projects will be undertaken based on the broad range of factors in our *Value Framework*. This includes lifecycle implications and what we term 'taking the broader view', meaning consideration of impacts on other strategies, initiatives or projects across the estate. However, we recognise that, even after preferred options have been identified using our *Value Framework*, finite time and resources mean that both the pace (i.e. the realistic achievable timescale) and the priority (i.e. the relative importance of these preferred options in comparison to one another) of implementing actions needs to be considered at both the site and national level. That is why we separate the options assessment process from the decision-making process.

Assessment of Pace and Priority

Prioritisation is the ranking or ordering of activities with reference to a set of factors. The priority chosen is dependent on the relative balance and weighting of these factors. As noted before, we give the highest priority where risks to people or the environment are identified as *intolerable*. At the same time, whatever initial priority is attached to a programme, it must be recognised that doing nothing may have consequences. In particular, a risk that is currently tolerable or broadly acceptable may degenerate if no action is taken to maintain the status quo.

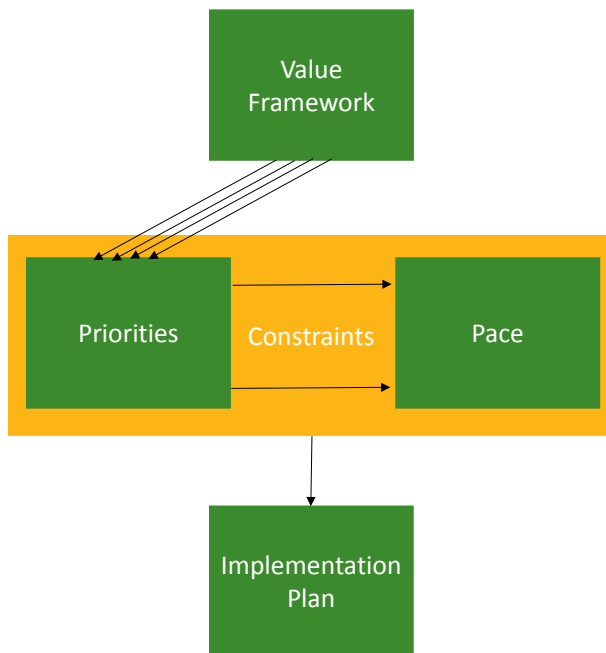
The pace at which an activity is implemented reflects both the start date (i.e. when the activity is scheduled to commence) and the rate at which that activity is progressed (i.e. the total duration of the activity).

Sometimes, even a high priority activity cannot be progressed rapidly, and the pace may be determined by a number of constraints. For example, a facility or waste inventory may present a high risk, and thus be identified as a high priority for risk reduction. However, the activity can only proceed slowly because time is required to establish a waste retrieval or disposal route and ensure that a higher risk is not

incurred during recovery operations. Consequently, we may take the opportunity to simultaneously progress and complete a lower priority activity where there are fewer constraints.

Combining our evaluation of options with an understanding of site and national priorities, and the recognition of constraints to progress activities, results in the process shown in Figure 1.

Figure 7: NDA Pace & Priority Process



This process can be broken into the main steps described below.

Step 1: Identify Priority

This is the identification of the ideal order in which activities (portfolios, programmes, projects or tasks) should be carried out. The NDA’s first priority is always the reduction of risk and hazard across its estate. However, establishing the level of risk or hazard reduction that can be achieved, and the broader implications of doing so, requires consideration of a range of factors, as laid out in our *Value Framework*. These include:

- i. Health and Safety
- ii. Security
- iii. Environment
- iv. Risk/hazard reduction
- v. Socio-economic impacts
- vi. Finance
- vii. Enabling the mission.

Consideration of these factors requires evaluation of uncertainty, assumptions and constraints relating to the identified preferred options, as well as assessing the confidence that the option can be implemented successfully.

The main output from this step is to identify an order in which the activities assessed should be considered.

In the case of prioritisation, ‘enabling the mission’ serves to identify opportunities. For example, the suitability of a new approach to decommission a high risk facility may be established by first

decommissioning a low risk facility. Alternatively, delivering a high risk reduction programme may mean that facilities and trained staff are available, enabling other lower risk reduction programmes to be driven forward ahead of the time that would otherwise have applied (i.e. apparently moving them up in priority). This makes best use of resources and enables the overall site or estate risk to be reduced in the most cost-effective manner.

Step 2: Identify Constraints

Establishing the priority in which initiatives or projects should be implemented represents an 'ideal world' position. In reality, there may be constraints that restrict what is achievable, or determine the order in which programmes can actually be pursued. Failing to understand 'real world' constraints can give a false impression of what is achievable and can actually result in delays to implementation and a slow-down in overall risk reduction across the site and across the estate.

It is important both to identify constraints and to evaluate them to determine whether they can be resolved or whether alternative approaches will be required. This is addressed in the *Value Framework*, where a distinction is made between absolute constraints (these are barriers that mean another way must be found) and conditional constraints (these are challenges that may be resolved).

The output from this step is expected to be a series of preferred options which progress through hazard reduction at a pace that is achievable.

Step 3: Review and Implement

As always, decision-making rests with the role of an identified decision-maker. Having established the pace and priority at which programmes can be progressed, and any associated opportunities for other programmes, an overall schedule must be compiled, reviewed and approved for implementation.

Appendix 3. National and International Strategies and Requirements

The output of any assessment must be compliant with legal and policy requirements, unless the assessment can propose a suitable, reasoned argument for changing the legal and policy requirements. The following identifies a range of mandatory controls and instruments current at the time of publication. This list is not exhaustive and requirements will change with time. We refer the reader to the ONR's 'Guide to Nuclear Regulation in the UK' for a fuller discussion of these requirements (available at <http://www.onr.org.uk/documents/a-guide-to-nuclear-regulation-in-the-uk.pdf>). It is the responsibility of the assessment panel and the decision-maker to ensure that any option complies with relevant statutory requirements prior to implementation. This list provides an indication of the range of obligations to be met by Site operators.

International Directives and initiatives

Much of the legislation in the UK is driven by international strategy and policy. Key International Directives and initiatives which have an influence on UK policy include the following:

- ♦ **The Basic Safety Standards Directives** (Council Directives 96/29/EURATOM and 2013/59/EURATOM) establish basic safety standards (BSS) for the protection of the health of workers and the general public against the dangers arising from ionising radiation. These Directives place a duty on Member States to keep the exposure risks faced by the general public, both individually and collectively, to a minimum (and certainly within prescribed limits). Fundamental to the BSS are the principles of justification, optimisation and limitation of exposures.
- ♦ **Integrated Pollution Prevention and Control** (Council Directive 2010/75/EU) is designed to prevent, reduce, and as far as possible eliminate pollution arising from industrial activities in compliance with the 'polluters pays' principle. The Directive covers emissions to water, air and land (including waste) from various industrial sources to achieve a high level of protection for the environment taken as a whole. The key principle is the requirement for an integrated approach to the granting of permits, taking account of the whole environmental performance and the public consultation in decision-making.
- ♦ **The Control of High-Activity Sealed Radioactive Sources and Orphan Sources** (Council Directive 2003/122/EURATOM; "the HASS Directive") is intended to provide strict control on the control of HASS, particularly in terms of maintaining accurate and up to date records of the location, composition and activity level of all HASS held in EU Member States.
- ♦ **The Framework Directive on Waste** (Council Directive 2008/98/EC) requires that Member States of the EU produce a National Waste Strategy setting out their policies on the disposal and recovery of waste. The main themes were developed from the concept of sustainable development and require that an integrated and adequate network of waste disposal installations be established with self-sufficiency in waste disposal in each member state. The Directive introduces the waste hierarchy, emphasises the recovery and recycling of waste, and includes permitting, registration and inspection requirements. The Directive notes that waste should be managed without adversely affecting the countryside or sites of special interest and without causing a nuisance through noise or odours.
- ♦ **The Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste** (2011/70/EURATOM) applies to spent fuel and radioactive waste management resulting from civilian activities. This Directive covers radioactive waste management from generation to disposal. Member states are responsible for keeping the generation of radioactive waste to the minimum practicable, safely managing spent fuel and radioactive waste, and governing

all stages of the management of spent fuel and radioactive waste. Member states should also establish a national framework for financing schemes for spent fuel and radioactive waste management and allocation of responsibilities.

- ◆ **OSPAR.** The OSPAR convention is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Union, cooperate to protect the marine environment of the North-East Atlantic. It covers the prevention and elimination of pollution from land-based sources, from dumping or incineration and from offshore sources. OSPAR includes strategies relating to eutrophication, hazardous substances, radioactive substances, specific activities (such as offshore industries) and biodiversity and ecosystems (to cover non-polluting human activities that can adversely affect the sea).

National Policy and Legislation

The following is not an exhaustive list of relevant policy and legislation within the UK, but provides an indication of the breadth of obligations to be considered when assessing options. For a full summary of Health and Safety legislation we refer the reader to the 'Regulatory Background' section of the ONR's Safety Assessment Principles (paragraphs 4–8 of the 2014 edition).

- ◆ **Environmental Permitting Regulations 2010.** In England and Wales, the formal basis for the disposal of radioactive waste from or on licensed sites is the EPR 2010. The EPR combined aspects of the Pollution Prevention and Control (England and Wales) Regulations 2000, the system of waste management licensing in Part II of the Environmental Protection Act 1990 and the Waste Management Licensing Regulations 1994. The regulations were extended in 2010 to cover waste discharge consents, groundwater permits and radioactive substances regulations. A main objective of the EPR is to ensure an optimal level of protection of the environment and the population is achieved and maintained.
- ◆ **Radioactive Substances Act 1993.** In Scotland and Northern Ireland, the management of radioactive material, and the accumulation and disposal of radioactive waste continues to be regulated through the RSA93. The primary purpose of this legislation is to provide for the protection of public health against harm from discharges of radioactive waste. Exposures to ionising radiation of the public are kept ALARA by the use of authorisation conditions requiring the operator to use BPM.
- ◆ **Ionising Radiation Regulations 1999.** The IRR99 set down requirements for the safety of people who work with ionising radiations, including radioactive substances, and effectively implement the BSS Directive. The Regulations impose a duty on employers to protect their employees and other persons against radiation arising from work with radioactive substances. It requires doses to be As Low As Reasonably Practicable (ALARP), and specifies dose limits which must not be exceeded.
- ◆ **High-activity Sealed Radioactive Sources and Orphan Sources Regulations 2005.** HASS sources are considered to present a greater hazard to the environment and human health than other sealed sources and as such have a number of extra controls applied to them. Mobile sources can include sealed radioactive sources. HASS was introduced into EPR 2010 in England and Wales. The HASS regulations continue to apply in Scotland and Northern Ireland.
- ◆ **Pollution Prevention and Control.** The PPC Regulations (2000) transposed the IPPC Directive into national legislation. The Regulations require relevant industries to ensure that discharges, emissions and waste generated due to activities and operations are managed to minimise impacts on the environment. In England and Wales, the PPC Regulations were repealed and replaced by the EPR. In Scotland, the Pollution Prevention and Control Regulations (2012) provide an update to the PPC (2000) regulations.

- ◆ **Environment Act 1995.** The Environment Act 1995 is the mechanism by which the European Framework Directive on Waste is implemented in the UK and effectively requires optimised decision-making to be applied in relation to waste management activities. In England and Wales, aspects of the Environment Act were repealed in 2007 and replaced by the EPA.
- ◆ **Nuclear Installations Act 1965.** Under the NIA65 36 standard licence conditions (LC) are attached to all nuclear site licences. These require licensees to make and implement adequate arrangements to ensure compliance.
- ◆ **Health and Safety at Work etc Act 1974.** The Health and Safety at work Act provides the legal framework to promote and encourage high standards of health and safety in places of work. The Act aims to protect both employees and the public from work activities. A key duty of the employer is to ensure the health, safety and welfare of employees as far as is reasonably practicable through provision of a safe place of employment, a safe working environment, safe systems of work and safety equipment.
- ◆ **Waste Regulations 2011.** The Waste (England and Wales) Regulations 2011 sets out the waste hierarchy, both with regard to the prevention of waste and when waste is transferred. These regulations aim to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving the efficiency of such use. The Regulations were amended in 2012 to place a duty on relevant authorities for the separate collection of waste paper, metal, plastic and glass.
- ◆ **Energy Act 2013.** This act established ONR as a statutory Public Corporation and defines ONR's purposes which include the regulation of nuclear safety; conventional health and safety on nuclear sites; nuclear security; nuclear safeguards and transport of radioactive material. The Energy Act empowers the Office for Nuclear Regulation based on the regulation principles of transparency, accountability, proportionality, consistency, and targeting. In the United Kingdom, the IAEA Safety Standards were used as a benchmark for the Safety Assessment Principles for Nuclear Facilities produced by the Office of Nuclear Regulation. Of particular relevance for decision-making are the Fundamental Principles that "*protection must be optimised to provide the highest level of safety that is reasonably practicable*", and that "*people, present and future, must be adequately protected against radiation risks.*"
- ◆ **Companies Act 2006.** The Companies Act 2006 forms the primary source of UK company law and sets out duties on behalf of the directors of companies to ensure they exercise their powers for a proper purpose. Directors are also required to promote the success of the company for the benefit of its members as a whole, but with regard to other factors including: the long-term consequences of decisions, the interests of employees and the impact on the community and the environment.
- ◆ **The Environmental Assessment of Plans and Programmes Regulations 2004 (The SEA Regulations)** provides for high level protection of the environment and integrates environmental considerations into the adoption of plans and programmes with a view to promoting sustainable development. These regulations adopt the Environmental Impact Assessment (EIA) Directive into UK law. Plans and programmes subject to these regulations are those that are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or Government, or are required by legislative, regulatory or administrative provisions.

Site-Specific Requirements

Nuclear sites must comply both with the conditions of their permit and their site licence.

- ◆ **Site licence conditions.** The Office of Nuclear Regulation issues site licences to a corporate body for specific activities on any given site. A set of 36 Standard Conditions applies to each licence. These Standard Conditions cover design, construction, operation and decommissioning. In particular, due priority must be given to safety when decisions are made and safety cases should be reviewed periodically. Operations that affect safety are subject to expert assessment by the Office of Nuclear Regulation, and may require prior agreement before work commences. In particular, Licence Condition 14 requires licensees to produce a safety case that demonstrates that relevant standards have been met and risks reduced to a level which is as low as reasonably practicable. In most cases, this requirement is fulfilled through established procedures and good practice, rather than an explicit cost and benefit comparison.
- ◆ **Environmental permit conditions.** In England and Wales, environmental permits are used to regulate those activities that may damage human health or the environment, and encourage best practice for operators undertaking these activities. Permit applications are assessed for environmental risk under both normal and abnormal operating conditions. The Environment Agency issues permits for radioactive substances activity, which are those activities involving the accumulation and disposal of radioactive waste. Environmental permits also regulate the security of radioactive material in line with National Counter Terrorism Security Office: Security Requirements for Radioactive Sources, May 2008. In particular, environmental permits are used to ensure that the dose from a regulated activity to a member of the public does not exceed a limit of 1 mSv per year, the dose to an individual from the discharges from a single site does not exceed 0.5 mSv per year, and the dose to an individual from the discharges from a single source does not exceed 0.3 mSv per year.
- ◆ **Site Authorisations under the Radioactive Substances Act (1993).** In Scotland and Northern Ireland authorisations for the accumulation and disposal of radioactive waste continue to be granted under the RSA93. In Scotland the regulatory authority is the Scottish Environment Protection Agency (SEPA). There are no nuclear licensed sites in Northern Ireland.

Appendix 4. Guiding Principles

A number of guiding principles are identified that have a broad applicability across a range of factors. These principles are included as a guide for the broader issues that may be considered whenever an assessment is undertaken.

Proximity

The proximity principle requires that waste is managed or disposed of as close as possible to the point of generation, reducing pollution from transportation. This principle is closely related to 'self-sufficiency' taken from the Framework Directive on Waste. Self-sufficiency requires Member States to take appropriate measures to provide an integrated network of disposal installations adequate to enable the European Union to become self-sufficient in waste treatment and disposal.

At the same time, it is recognised that for certain types of wastes, including for some LLW, the development of local, regional or national facilities (see, for instance, the low level waste management policy [1]) may require the transport of materials. Where it is not feasible to treat at or in close proximity to source, preferred transportation options (e.g. water or rail) may serve to minimise environmental impacts. In some instances, longer distance travel by rail or sea link may be preferable to road transport over shorter distances. In other instances, transport to a remote location for treatment (e.g. to facilitate recycling) may be preferable to disposal in close proximity to source.

Clearly, the proximity principle requires a broad overview of options and cannot be applied as a simple hierarchy based on distance. Transport miles may be considered as a factor when decision-making, however this is only one factor among many that is encompassed by the proximity principle.

The proximity principle has been applied in the past principally to waste management. However, the proximity principle can also be applied to other processes. Whenever there is production and generation of materials, consideration should be given to where this production occurs relative both to the source of raw materials and to the point of consumption. This principle may be applied at the plant level or on a national level.

Proportionality

The concept of proportionality is that the level of effort or cost expended to resolve an issue should be linked to the scale of the challenge, the range of options available, and the extent to which precedent and established good practice can be used to assist in the decision-making process. Consequently, the demonstration of an optimised options assessment can vary from a detailed study for a complex operation with no established good practice, to a short description of operation in accordance with recognised standards for a less complex operation or one with well-established good practice.

The Environment Agencies offer the guidance that anything further that can be done to reduce detriments should be implemented unless the associated money, time, trouble or other costs or efforts are grossly disproportionate to the benefits gained.

Whilst there is no authoritative guidance as to what determines whether cost is grossly disproportionate to benefit the Treasury [2] has accepted the general argument that there is an inherent fairness to assigning higher levels of disproportionality for higher impacts. According to HSE [3] guidance for ALARP determinations, judgements on gross disproportion should take into account:

- the number of people (workers and public) that may be exposed to radiological risk;
- the magnitude, and frequency, of the consequences;
- nuclear security and safeguards requirements;

- non-radiological hazards, resources used (e.g. energy) and other economic, societal or environmental factors.

The process of identifying an optimal decision often involves compromises between different factors to achieve the best overall outcome. Consequently, determining when an action is grossly disproportionate to the benefits is not straightforward.

Example: Assessing Benefits

In general, wherever a simple, low cost, action can be undertaken to reduce an impact, this action will almost always be justified. For example, removing packaging before taking items into a controlled area may represent a relatively small saving in total waste volumes. Nonetheless, the level of effort required at an individual and corporate level is sufficiently small that it will almost always represent good practice. At the same time, a distinction is required in expressing benefits (or detriments) in relative or absolute terms. Thus, reducing a dose from 0.1 μSv to 0.001 μSv represents a relative reduction of two orders of magnitude, but is very small in absolute terms.

Example: Assessing Costs

Cost may not be a simple measure of financial spend, or of effort. For instance, installing a treatment plant to reduce waste generation or impact may itself present an environmental or social burden in terms of land occupied (and loss of ecological habitat), raw materials, energy use, greenhouse gas emissions or other non-radiological discharges. Secondary costs may involve additional regulatory requirements and permits or H&S considerations.

The concept of proportionality also extends to the assessment process and accompanying documentation. The primary output of an options assessment should be fit—for-purpose documents that provide a basis for external scrutiny (for example, by regulators or other relevant stakeholders). In principle, documents should guide the reader through the assessment process, without introducing material not used as part of the assessment basis. Documentation should be as short as practicable but as long as necessary.

Precautionary Principle

The basis of the precautionary principle is that, *“where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”* [4]

The Commission of the European Communities issued a Communication on the Precautionary Principle [5], indicating that the principle should be considered within a structured approach to the analysis of risk which comprises three elements: risk assessment, risk management and risk communication. Where action is deemed necessary, measures based on the precautionary principle should be:

- ◆ proportional to the chosen level of protection;
- ◆ non-discriminatory in their application;
- ◆ consistent with similar measures already taken;
- ◆ based on an examination of the potential benefits and costs of action or lack of action;
- ◆ subject to review, in the light of new scientific data;
- ◆ capable of assigning responsibility for producing the scientific evidence necessary for a more comprehensive risk assessment.

The Precautionary Principle allows policy makers to make discretionary decisions in situations where there is the possibility of harm, even when extensive scientific knowledge on the matter is lacking. The principle implies that there is a social responsibility to protect the public from exposure to harm whenever there is a plausible risk.

Waste Hierarchy and Waste Form

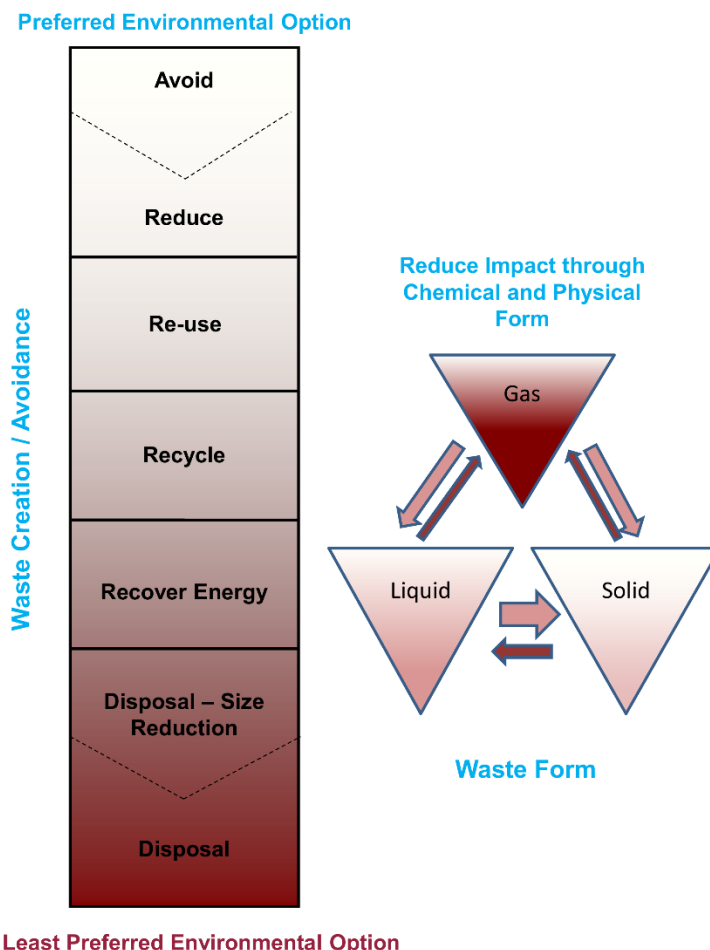
Waste management options should be considered within the context of the waste hierarchy, which determines the best outcomes for the environment [6]. The waste hierarchy applies to all waste, including hazardous waste and radioactive waste. Adoption of the waste hierarchy is embedded in Waste (England and Wales) Regulations 2011 and UK policy for the management of solid, liquid or gaseous radioactive wastes [e.g. 1, 7, 8, 9, 10]. The waste hierarchy means:

- ◆ not creating waste where practicable;
- ◆ reducing waste arisings by activity, mass or volume to a minimum through the design and operation of processes and equipment, including effective waste characterisation, sorting and segregation, volume reduction and removal of surface contamination;
- ◆ minimising quantities of waste requiring disposal through decay storage, re-use, recycling or incineration (including recovery of energy from waste schemes).

Disposal of waste is always the least preferred option [11]. Where disposals are necessary, BAT should be applied to minimise impacts [12]. Options for the management of radioactive waste include discharge of gaseous or liquid radioactivity into the environment ('dilute and disperse') or trapping in a solid, concentrated form for storage and eventual disposal ('concentrate and contain'). The Government's view is that 'concentrate and contain' is generally appropriate for managing radioactive wastes, although if it can be demonstrated that a 'dilute and disperse' option is BAT, such an option could be preferred [12].

A further requirement within permits issued under EPR is that the Operator shall minimise the activity of radioactive waste that will require disposal and, where disposal is required, shall do so in a form and manner so as to minimise the radiological effects on the environment and members of the public. Under the Nuclear Installations Act [13], standard licence condition 32 [14] also requires adequate arrangements to minimise the rate of production and total quantity of radioactive waste and to record such waste.

Figure 8: Waste Management Principles



Whilst there is a general preference for solidification of wastes, optimisation of waste form and potential impact may include chemical rather than physical changes of state (e.g. pH of aqueous wastes). In addition, permit conditions may raise specific considerations such as the exclusion of entrained solids, gases and non-aqueous liquids from radioactive aqueous waste or the removal of suspended solids from waste oils. In all cases, optimisation of radiation doses is the overriding requirement rather than application of the waste hierarchy.

Intergenerational and intragenerational equity

Intergenerational equity refers to the concept that both present and future generations have a right to the benefits of the Earth and its resources. The belief in intergenerational equity essentially forces decisions to be considered both in terms of the benefit and detriment to the current generation, and the benefit and detriment of future generations. In contrast, intragenerational equity refers to the concept that all nations and individuals of the present generation have a right to the benefits of the Earth and its resources. As part of NDA’s commitment to environmental responsibility, we believe that intergenerational and intragenerational equity should be considered when applying the Value Framework.

References

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- 2 HM Treasury (1996). The Setting of Safety Standards. A Report by an Interdepartmental Group and External Advisers. HM Treasury, Parliament Street, London
- 3 HSE. Principles for Cost Benefit Analysis (CBA) in support of ALARP decisions.
- 4 UN General Assembly (1992). Rio Declaration on Environment and Development: Annex 1 of Report of the United Nations Conference on Environment & Development.
- 5 Commission of the European Communities (2000). Communication from the Commission on the Precautionary Principle. Brussels, 02.02.2000, COM(2000) 1
- 6 DEFRA (2011). Guidance on Applying the Waste Hierarchy. June 2011
- 7 Environment Agency (2009). Nuclear Sector Plan, Environmental Sector Plan for the Nuclear Industry, Issue 2.
- 8 Defra (2007). Waste Strategy for England 2007. Command 7986, HMSO, Norwich. [note – equivalent documents are available for Wales and Scotland]
- 9 NDA (2009) UK Management of Solid LLW from the Nuclear Industry.
- 10 Office of Nuclear Regulation (2014), Safety Assessment Principles for Nuclear Facilities, 2014 Edition, Revision 0
- 11 LLWR Ltd (2009) UK Management of Solid Low Level Radioactive Waste from the Nuclear Industry: Guidance for Application of the Waste Management Hierarchy.
- 12 Nuclear Industry Code of Practice (NICO_P; 2010). Best Available Techniques (BAT) for the Management of the Generation and Disposal of Radioactive Wastes. December 2010.
- 13 Nuclear Installations Act 1965 (as amended)
- 14 HSE. Nuclear Site Licence Conditions

Appendix 5. Glossary and Definitions

Terms and acronyms used in this report are defined below. For a comprehensive list of terms and definitions used in nuclear safety and radiological protection, see: IAEA “Safety Glossary, Terminology used in nuclear safety and radiation protection” 2007⁶.

ALARA ALARP	As Low As Reasonably Achievable (economic and social factors being taken into account). Radiation doses comply with ALARA when they have been reduced to a level that represents a balance between dose and other factors (including economics). This is a statement of the optimisation principle. The term ALARP arises in the Health and Safety at Work etc. Act 1974, which requires “provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health”. The phrase So Far As Is Reasonably Practicable (SFAIRP), and similar clauses, is interpreted as leading to a requirement that risks must be reduced to a level that is As Low As Reasonably Practicable (ALARP). Where established standards and good practice are not clearly evident, for a risk to be ALARP it must be possible to demonstrate that the costs of any further measures would be grossly disproportionate to the reduction in risks achieved by their adoption.
Authorisation	The granting of regulatory permission to undertake an activity under licence. In this document, the more generic term ‘permit’ is used, except where Authorisations granted under RSA93 are specifically referred to, or where information is cited direct from a source which uses the term Authorisation.
BAT	Best Available Techniques: the latest stage of development of processes, facilities or methods of operation which it is practicable to implement, taking into account costs and environmental benefits. BAT applies throughout the lifetime of a process, from design to implementation, operation, maintenance and decommissioning. BAT covers not only the technology but also the way in which it is implemented. BAT is defined in EC Directive 96/61 for the purposes of reducing emissions and associated impacts on the environment. Hence it has a particular application for waste arisings and disposals.
B&B	Bed and breakfast.
BPM	Best Practicable Means. BPM for radioactive waste management represents the, “ <i>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> ”. BPM requires operators to take all reasonably practicable measures in the design, operation and management of their facilities to minimise disposals of radioactive waste, so as to achieve a high standard of protection for the public and the environment. BPM applies to minimising waste creation, abating discharges, and monitoring of plant, discharges and the environment. It takes account of the availability and cost of measures, operator safety and the benefits to be gained. BPM continues to be required by the SEPA in authorisations issued under the Radioactive Substances Act. BPM and BAT are considered to be essentially equivalent.
BSSD	Basic Safety Standard Directive (96/29/EURATOM)
Discharge	The disposal of material in liquid or gaseous form by emission to the environment.
Disposal	The long-term disposal of solid, liquid or gaseous materials either by emission to the environment or by emplacement in such a way that no retrieval of the material is intended. The term ‘disposal’ is used throughout this document in place of the more restrictive term ‘discharge’ except where citing information from other sources or where the more restrictive term is clearly appropriate.

⁶ International Atomic Energy Agency (IAEA). IAEA Safety Glossary: terminology used in nuclear safety and radiation protection. 2007

Environment	<p>There is no fixed definition of the ‘environment’ within national law, as it is usually taken to represent the sum of the surroundings – and therefore it is a dependent quantity, rather than a fixed, independent, article. The environment may be considered to include both the living and the physical surroundings, and their interactions.</p> <p>The interactions between individual members of different species in the environment are complex, and competitive. Any living organism is constantly under stress from other organisms and from physical agents. The relative numbers of individuals and species fluctuate in time. Over long periods of time, such as may be considered with respect to geological facilities for waste management and disposal, species may vary as a result of evolutionary changes, themselves a product of various stressors.</p>
EIA	Environmental Impact Assessment
EPR 2010	Environmental Permitting Regulations (2010)
Environmental Sustainability	Sustainability is based on meeting the needs of the present without compromising the ability of future generations to meet their own and requires an analysis of the environmental, social and economic impacts.
Factor	A quality, property, or performance measure of an option that enables different options to be scored or ranked in relation to one another. Depending on the factor concerned, the scoring or ranking process may lie anywhere in the range from entirely objective to entirely subjective. Each factor may form a focal part of discussion of an option or be justifiably omitted from further consideration.
HASS	High Activity Sealed Radioactive Sources
HLW	High Level Waste
HSE	Health and Safety Executive.
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IRR	Ionising Radiations Regulations
ILW	Intermediate Level Radioactive Waste
Justification	The benefits and detriments of any practice which could result in exposure to ionising radiation must be assessed prior to the practice being permitted. If the benefits outweigh the detriments, the practice is justified.
Limitation	Limitation provides a mechanism of dose limits which ensure that no individual shall be exposed to ionising radiation leading to an unacceptable risk under normal circumstances.
LLW	Low Level Radioactive Waste
LV-VLLW	Low Volume Very Low Level Radioactive Waste
Licensee	An operator licensed under NIA65
NHB	Non-Human Biota
NIA65	The Nuclear Installations Act 1965
NII	Nuclear Installations Inspectorate
NLS	Nuclear Licensed Site. The term refers to sites that have a nuclear site licence under the Nuclear Installations Act 1965. More broadly, it may include sites that have applied for, but not yet been granted, such a licence.
ONR	Office of Nuclear Regulation
Optimisation	Optimisation is the process whereby an operator selects the technical or management option that best meets the full range of relevant health, safety, environmental and security objectives, taking into account factors such as social and economic impacts.
Option	A potential means of achieving a specified objective.
Options assessment	Any formal and recorded method by which the ‘best’ solution is determined from a number of possible alternatives.
OSPAR	Oslo and Paris Convention for the protection of the marine environment in the north-east Atlantic. The UK is a signatory to this Convention, and is committed to reducing discharges of pollution, including radioactive substances, to the sea.

Permit	The granting of regulatory permission to undertake an activity under licence. In this document, the term permit is used to embrace all authorised or permitted activities except where specific reference is made to terms under RSA93 or where material is cited direct from source.
PPC	Pollution Prevention and Control.
Precautionary Principle	Where there are reasonable grounds for suspecting that an action or policy presents a risk of causing harm to the public or to the environment then, even in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is not harmful falls on those taking the action.
Proximity Principle	Enabling waste to be disposed of in one the nearest practicable installation by means of the most appropriate methods and technologies in order to ensure a high standard of protection to the environment and public health.
QA	Quality Assurance
QE	Qualified Expert
R&D	Research and Development
Ranking	Placing options in order from highest to lowest against a particular attribute.
Regulated facility	A collective term for the range of activities permitted under the Environmental Permitting Regulations
REPs	Radioactive Substances Regulation – Environmental Principles. Environment Agency guidance which sets out, at a high level, the principles which the Environment Agency applies to RSR.
RSA	Radioactive Substances Act
RSR	Radioactive Substances Regulation.
SAPs	Safety Assessment Principles. HSE guidance which sets out, at a high level, the principles which the HSE applies to safety cases.
SAC	Special Area of Conservation
SCBA	Social Cost Benefit Analysis. A way that HM Treasury uses to express the costs and benefits of a proposal to UK society in monetary terms.
Scoring	Placing a numerical value on an option in relation to a particular attribute.
Screening Criterion	A criterion representing basic expectations in relation to the practicability of proposed options; used to exclude one or more proposed options from further consideration. May be based on feasibility, legal, policy or regulatory constraints, or manifestly inferior performance against important attributes.
SeA	Socio-economic Assessment
SEA	Strategic Environmental Assessment
SED	Safety and Environmental Detriment
SLC	Site License Company
SMS	Strategic Management System
SPA	Special Protection Area for Birds
SQEP	Suitably Qualified and Experienced Person
SSSI	Site of Special Scientific Interest
Stakeholder	Any person or organisation that considers it has an interest in the BAT/options study concerned. Stakeholders may include the relevant nuclear site operator, the regulators and Government departments and persons or organisations other than these such as the local community, suppliers and other groups.
Sustainable Development	Development which meets the needs of the present without compromising the ability of future generations to meet their own needs. Specific to radioactive waste, the Government's policy is to 'ensure that radioactive waste is managed safely and that the present generation, which receives the benefit of nuclear power, meets its responsibilities to future generations'.
Topic Strategy	A uniquely defined subject on which NDA expresses a strategic position and defines the approach to be adopted by Site Licence Companies in delivering their site strategies.

TRA	Technical Readiness Assessment
TRL	Technical Readiness Level
Uncertainty	Lack of definite information. Uncertainty is treated here as a factor extrinsic to the system under consideration and can, in principle, be reduced through acquisition of further knowledge or data: <i>cf</i> variability.
Variability	The spread of data within a set. Variability is treated here as intrinsic to the system and is not influenced by the acquisition of further information: <i>cf</i> uncertainty.
Waste Hierarchy	A principle of waste management which requires that (in order of preference) wastes be: Avoided; Minimised; Reused; Recycled; and, Disposed of.