

UK NUCLEAR DECOMMISSIONING AUTHORITY – VALUE FRAMEWORK, ITS DEVELOPMENT AND ROLE IN DECISION MAKING

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ABSTRACT

As part of its day to day business NDA must be able to demonstrate that it is delivering value for money across its entire estate, as this is essential to securing funding from government and demonstrating to stakeholders that NDA is delivering on its mission.

Value comes in many forms such as an improved environment, hazard reduction, changes in sky line, social amenities, money, employment etc. Depending on the perspective of the receiver, and their closeness to the effected area, the relative weighting they place on the different aspects of value will vary. Therefore the challenge to NDA has been how to get a consistent approach to measuring value that is broadly acceptable to stakeholders and allows the different aspects of value to be compared and decisions made on a national basis.

This paper describes the work undertaken by NDA to develop a Value Framework to support decision making at both the strategic and tactical level and addresses the following topics:

- The relationship between the value framework and UK government guidance on business case development and options appraisal
- The development of the value framework tool kit including previous work on the NDA prioritisation process and the derivation of Safety and Environmental Detriment scores
- How NDA uses the value framework in its decision making processes

1. RELATIONSHIP BETWEEN VALUE FRAMEWORK AND UK GOVERNMENT GUIDANCE ON BUSINESS CASE DEVELOPMENT AND OPTIONS APPRAISAL

Over a number of years the UK Government through HM Treasury has developed a range of guidance on options appraisal and value assessment which it has published in 'The Green Book' – Appraisal and Evaluation In Central Government. This guidance is mandatory on all government departments, local authorities, and non departmental government bodies such as the NDA. The Green Book provides clear guidance on how monetary impacts should be evaluated and the impact of time on these but also states that money is not the only consideration when determining value and that other benefits and detriments should be factored into any analysis.

Green Book provides a range of examples of benefits and detriments that might need to be considered and splits these into two types:

- Tangible benefits and detriments – ie those which can be measured and ideally to which a monetary value can be assigned
- Intangible benefits and detriments – ie factors that are important and need to be considered when making a final decision but which cannot be readily quantified.

However, Green Book represents general guidance and therefore cannot cover all aspects of value across all spheres of government activity, therefore it places the requirement on individual organisations to develop there own detailed guidance, on what they value and how to measure it, to supplement the general guidance.

2. WHAT IS THE VALUE FRAMEWORK

The Value Framework is NDA's departmental specific guidance on what it values and how to measure it. It can be considered

to be a tool kit that can be used by NDA, its contractors and stakeholders to consistently assess the value and impact of different strategies, funding scenarios and options. It consists of a set of criteria (attributes), that represent the key aspects of NDA's mission, which have been further subdivided into individual metrics to which national valuations can be assigned. This allows direct comparison and summation to provide an overall assessment of the value that is being delivered.

The Framework cannot be used in isolation and must operate within and support wider decision making processes. Like any tool kit some tools are used to craft out the overall shape whilst others are used with these to apply the finer detail, this means some metrics and attributes will be more influential than others dependent on the level of the decision that is being made.

3. THE VALUE FRAMEWORK PROJECT

The Value Framework project has been split into four distinct phases, these being:

- Initial scoping work to investigate what a 'Value Framework' might look like and taking account of what is being done elsewhere in government and within other public bodies.
- Development of the NDA Value Framework and initial embedding within NDAs business processes
- Initial roll out of the Value Framework across the NDA estate and refinement based on feedback from initial application.
- Post roll out monitoring, refinement and sharing of good practice.

The first two phases of the project are now complete and the guidance on the development of business cases (Reference 1) is now being rolled out across the NDA estate. This process including initial feedback and refinement is expected to be complete by the end of this financial year.

4. DEVELOPMENT OF VALUE FRAMEWORK METRICS

The first stage of the project involved scoping out what a Value Framework might look like, and took account of what has been done elsewhere in government and other public bodies. The main conclusions from this work were:

- The value framework should be based on a cost benefit approach where all principle benefits are as far as practical valued in monetary terms.
- The methodology described in the Green Book should be used as the basis for combining values and costs and for taking account of the impact of time on perceived value.

- Stakeholder engagement in decision making would be through the decision making processes which the value framework supports rather than the framework itself. However, the views of stakeholders must be taken account of during the development of the tool and the previous work on the development of the NDA prioritisation process (Reference 2) would be used as a starting point.

As part of the development of the NDA Prioritisation process (References 2 and 3) the Prioritisation Working Group (PWG) identified six attributes that incorporate both stakeholder concerns and NDA's mission, these being:

- Hazard Reduction
- Safety and security
- Environment
- Advancing the programme
- Value For Money
- Socio – economics

As the assessment of value for money is the purpose of the value framework then there is no requirement to have a separate value for money attribute. Similarly advancing the programme can be considered to be made up of two factors, these being:

- The timing of the delivery of the other core attributes of hazard reduction, safety etc.
- The timing of delivery of other factors that are less tangible, such as skyline change or the early de-licensing of a site, and are driven by reputational and political considerations.

Because skyline change etc are heavily influenced by the politics of the day and application of 'Green Book' methodology deals with the impacts of time on value it was decided no additional metrics would be required over and above those contained within the other remaining attributes. As political and reputational considerations are important to the final decision but cannot be easily measured these would be used as potential modifiers by the decision makers when making the final decision.

Therefore out of the six attributes originally identified by the PWG only four need to be considered with respect to the development of specific metrics, these being:

- Hazard Reduction
- Safety and Security
- Environment
- Socio-economics

These findings mirror the deliberations of the PWG (Reference 2) which reached similar conclusions with respect to the

development of the project benefit measure (Reference 4) within the prioritisation process, and can be considered to be a crude forerunner of a potential value framework.

In addition to these direct cost and income also need to be taken into account, and it is essential that in developing the metrics that double counting between the different attributes and metrics is avoided.

4.1 Cost

Cost is measured in pounds and can be considered to be made up of two components:

- The cost of keeping the NDA estate (Sites, Facilities and Offices) compliant with primary legislation ie Safe, Secure and Environmentally compliant
- The cost of doing physical work eg decommissioning and remediation activities

Between them these two elements of cost already contain a large consideration of the requirements from the other attributes and therefore there is significant potential for double counting. Therefore in developing the other metrics efforts have been made to avoid these, typical examples of where double counting occurs are:

- Environmental metrics based on waste volume reduction as waste disposal is generally charged for by volume and therefore an option that reduces waste volumes will also have an impact on the cost of the option. Therefore what needs to be clearly understood is the additional environmental value of waste volume reduction that is not accounted for by cost.
- Safety metrics which compare accident statistics eg working on the ground is safer than working at height. In reality both work activities must comply with the requirements of the Health And Safety at Work Act and therefore must offer equivalent levels of safety. This requirement is then reflected in the costs of the options and the safe systems of work that have to be put in place ie it is already covered in cost as part of the need to comply with primary statute.

4.2 Safety And Security Metrics

Security

All licensed sites and government facilities are required to have a security plan by law and the costs of enacting this plan are covered within the care and maintenance costs of the facility. Other security concerns are driven by the facilities contents and the threats they pose if they were released, as such these are

already covered within the Safety and Environmental Detriment (SED) score which is used to express hazard (see Section 4.4).

Therefore on the basis of the above, which aligns with the previous deliberations of the Prioritisation Working Group (Reference 2) no additional metrics have been developed to cover security considerations.

Safety

On the whole safety is not discretionary and the requirement to work safely is enshrined within primary legislation. Because of this people undertaking work are required to carry out risk assessments and where necessary to produce safe systems of work to ensure that the risk of accidents and injury are kept As Low As Reasonably Practicable (ALARP). This means that working safely is already built into the base cost of doing work and hence covered under cost.

However, having said this there are some areas of safety where there is an element of discretion, the main ones from a nuclear perspective being:

- The amount of radiation dose individual workers receive within the limits set by primary legislation.
- The distance and method by which goods and people are transported because whilst society accepts there are risks associated with transport it also accepts that the societal benefits outweigh the risks.

Another aspect of safety is the perceived safety concerns which arise from the existence of potentially hazardous inventories contained within ageing facilities. This aspect of safety has not been included within the safety metrics as it is already accounted for via the SED score as detailed in Section 4.4.

Valuation Of Worker Dose Uptake

The valuation of worker dose uptake is something that has been discussed within the nuclear industry over many years (Reference 5), and has formed the basis of a number of discussions between the site license holders and the regulators. In 2004 the NII and British Nuclear Group published a document on joint understandings which contained agreed guidance on the valuation of worker dose for use in cost benefit analysis. This guidance (Reference 6) recommended the following:

1. For individual worker dose uptakes below 5mSv/y a figure of £50k/manSv should be used.

2. For individual worker dose uptakes above 10mSv/y a figure of £100k/manSv should be used.
3. For doses in between these levels then the numbers should be scaled accordingly.

Given that these figures have been recognised by the principal regulator and are based on previous published information from the National Radiological Protection Board (NRPB), these are the figures that have been adopted within the Value Framework.

Valuation Of Safety Aspects Of Transport

The main safety impact of transport is as a result of accidents and the economic consequences of these. The Department for Transport (DfT) publishes figures on UK road accident statistics including the average cost of accidents, number of accidents and miles traveled. Using these statistics from the DfT web site the following data can be extracted:

Average cost of accident based on 2005 report (Reference 7)	£89,920	
Average cost escalated to 2008 values	£98,435	RPI assumed to be 3.1%
Total road miles 1997 to 2007	8,242,700,000,000	All roads
Total number of accidents	4,926,746	These are reported accidents
Probability of accident per mile travelled	0.0000006/mile	
Cost of accident per mile travelled	£0.06/mile	Probability*average cost

Rail, sea, and air transport are considerably safer than road transport hence given the small figure associated with road transport a decision has been taken to discount these as negligible at this point in time.

4.3 Environment

There are many aspects of environment that need to be considered and these include the impact of radiological and non radiological discharges, disturbance of wildlife, noise, congestion, and visual intrusion. All of these are important.

However, in looking at these they can be clearly categorised into those which are a local issue and those which have national implications. Noise, congestion, disturbance and visual intrusion are generally local issues and therefore should not be considered in a national process of valuation but instead should be used as a modifier within the wider decision making process.

Loss of habitat and impact on endangered species can be considered to be a national issue even though the impacts occur at a local level. Sites of Special Scientific Interest (SSSIs) and other protected habitats are covered by the European Habitats Directive which places a number of requirements on anybody seeking to carry out development in these areas. The impact of these, including the requirement to create equivalent replacement habitat, is reflected directly in the overall project cost and therefore should not be further accounted for within a separate environmental metric.

Based on the above this reduces the environmental attribute to the consideration of radiological and non radiological discharges.

Valuation Of Radiological Discharges

Radiological discharges from the NDAs licensed sites are regulated by the Environment Agency (EA) or Scottish Environmental Protection Agency (SEPA) and they have been effective in driving down the discharges over many years to the current position where radiological discharges are already at very low levels and the costs of meeting the requirements of the sites discharge authorisations are already built into the sites operating costs. Therefore it is the impact of the residual discharges that needs to be considered within any environmental valuation if double counting is to be avoided.

There is a wide range of literature covering the impact of radiological discharges on the environment and in particular the impact this has on people. For human populations this impact is generally expressed as units of collective dose to a critical group eg people living near the site, UK population, European population etc integrated over a stated time period eg 1 year, 500 years, infinity etc. In 1986 the NRPB issued guidance on the valuation of collective dose for use in cost benefit analysis and this was further revised in 1993 (Reference 5) to a figure of £20k/manSv for doses to the general public which when escalated to present day values is ~£25k/manSv.

Other higher values for collective dose have been used within studies such as the European Externalities of Energy project (ExternE), but for the purposes of the value framework the £25k/manSv figure has been adopted on the basis that sensitivity analysis can be used to demonstrate how sensitive any final decision is to the choice of value.

The other big question that has arisen from the concept of collective dose is the timescales over which the dose to the population should be integrated and also the size of the effected population. A lot of very small doses integrated over infinity for the world population will give rise to a very large collective dose even though it could be argued that the true impact on the individuals is negligible. This has led to some people questioning the value of collective dose as a measure (Reference 8) and has coincided with the International Committee on Radiological Protection (ICRP) issuing revised guidance on the use of collective dose (Reference 9). However, to date no feasible alternative measure has been proposed and in lieu of this a recommendation has been made that collective dose calculations be limited to European population and truncated at 500 years (Reference 10). Therefore this is the interpretation of collective dose that has been incorporated into the value framework.

Valuation Of Non Radiological Discharges

Non radiological discharges occur in a variety of forms and there has been a number of European research programmes such as ExternE commissioned to look at the impacts of such discharges. In looking at the sources of emission they have carried out a full life cycle analysis and sought to separate the costs that are born directly by the consumer through the purchase price of the goods and services and the costs which are born by society as a whole but not paid for by any individual. The direct costs are already accounted for within the overall project costs therefore it is the costs that are generally born by society (the externality costs) that need to be considered.

Therefore for example the full costs of a sheet of steel are made up of the purchase price of the steel plus the associated externality costs arising from CO₂, NO_x, and SO_x emissions from the ore extraction, transport, and manufacture of the steel sheet.

Because of society's rising awareness of the impact of greenhouse gases on the environment HM Treasury has issued guidance on the valuation of CO₂ and other greenhouse gas emissions (Reference 11). This puts an initial starting price on CO₂ emissions of £25/te with a yearly escalator thereafter, and it is this guidance which has been included within the value framework as greenhouse gases are seen as the major concern at the current time. To assist in the assessment of carbon detriment the EA has also published a carbon calculator which contains CO₂ values for common construction materials and activities.

Although it is feasible to derive values for other non radiological emissions from the European work these have not

been included within the value framework at the present time so as to reduce the overall complexity.

4.4 Hazard Reduction Metrics

What do we mean by hazard?

Whether something is considered hazardous, or otherwise, depends on the circumstances prevailing at the time and the perspective of the observer, as such there is no direct or consistent measure of hazard. However, as part of the development of the NDA prioritisation process (Reference 2) a consistent means of expressing the concern generated by different facilities has been created, and has been used across the NDA estate to produce the NDA Hazard Baseline (Reference 12). This measure, the Safety and Environmental Detriment (SED) score, takes account of the potential impact of the stored material being released into the environment along with its conditions of storage, and to some extent expresses the threat posed by the existence of the facility and its contents.

Whilst the SED score provides an indication of the threat or concern posed by a facility it takes no account of the likelihood other than the recognition that materials in a poor ageing building are more likely to be released than those in a new building built to modern standards.

Should risk be factored into any valuation of hazard?

The calculation of the SED score is based on the assumption that all the facility contents are released and they are released in their most dispersible form, and therefore it represents the worst case scenario. In probabilistic risk assessment this impact is then weighted by the risk function to derive a range of outcomes and likelihoods and under most scenarios the full release of the building contents will rank as extremely unlikely to what most would regard as improbable.

However, highly improbable events occur on a regular basis and this is borne out by analysis of major incidents which seldom have a single causal event but require a number of specific circumstances to occur in series or simultaneously. Therefore the only conclusion that can be drawn from this is whilst something exists the worst case can happen, and such events are binary by nature 'they either happen or they don't'. Because it did not happen today does not mean it cannot happen tomorrow.

This leads to the conclusion that for extreme events the application of risk weightings is not appropriate as the purpose of the UK regulatory regime is to keep facilities in the broadly tolerable risk region, and this is accounted for within the care and maintenance costs for the facility. Therefore any valuation of hazard must just value the threat or concern posed by the facility.

Hazard valuation

The value different people will place on the removal of concern will depend on their proximity to the source of concern, their personal circumstances, and a host of other factors. As such it is unlikely that a consistent agreed value could be arrived at for the value of a unit of hazard reduction. However this is not a problem unique to the nuclear industry and parallels can be drawn with the dilemma faced by the National Institute of Clinical Excellence (NICE) regarding the valuation of Quality Adjusted Life Years (QALYs), as the value a person would place on a life varies based on circumstance, disease characteristics, proximity, family etc. Because of this NICE do not have a declared value for a QALY but instead use cost effectiveness analysis where different options are evaluated based on the numbers of QALYs delivered against costs expended.

This is the approach that can be adopted for valuation of SED as all other attributes can be represented in monetary terms (Figure 1), and hazard reduction is the main benefit delivered by NDAs clean up programme.

Adoption of a cost effectiveness approach to Hazard Reduction gets around the general issue of having an agreed valuation for a unit of hazard reduction, but does not answer the question for key stakeholders in terms of 'What am I getting for my money' expressed in terms that they readily understand. In the case of NICE they have a shadow valuation for a QALY of approximately £30k but because of the scale of the SED score it does not readily lend itself to this approach. Instead a comparative approach has been used and an impact/consequence table developed based on a crosswalk between the International Nuclear Event Scale, SED scores and calibrating events based on the worst case incident a facility could create. This approach demonstrates that there is significant value in reducing the SED score associated with facilities at the very high end of the SED scale, whilst for something such as a reactor block once it has been put into safe store the value of the resultant hazard reduction is very low ie cost and other factors may be a driver for decommissioning the reactor block but hazard alone is not a driver.

4.5 Socio-Economic Metrics

NDA's mission is to remediate and close down the sites for which it is responsible, and therefore having metrics directly linked to new or continuing levels of employment could result in decisions that run contrary to the overall thrust of NDA's mission. However, whilst NDA is not directly charged with creating or maintaining employment it has a secondary duty to consider the impact its decisions may have on the local communities around its sites. This dilemma was recognised by the PWG (Reference 2) when developing the NDA prioritisation process and resulted in the decision to consider

impact on local economies as a modifier within the wider decision making process.

The issue of how to decide where to generate economic benefits or impacts is not unique to NDA and is an issue faced by government as a whole. In the 'Green Book', it is recognised that a pound spent in a deprived area may be worth more than a pound spent in an affluent area and because of this it is recommended that 'distributional' weightings are developed. In the NDA context this means that if there is a choice of where an impact or benefit should be delivered then the distributional weighting should be applied to account for the potential economic impact on a deprived area compared to an affluent area.

5. USE OF VALUE FRAMEWORK IN DECISION MAKING

There are two main areas of decision making within the NDA where the value framework is used, these are:

- Sanctioning individual work programmes and projects
- Global distribution of funding across the NDA estate

Figure 2 shows the process for the sanctioning of individual programmes and projects through the development and approval of business cases. The value framework is integrated into this through the application of Green Book for options appraisal and the adoption of the Treasury Five Case Model (Reference 13) for the format and content of business cases.

The development of programme and project options can be considered to be a 'bottom up' process where the value of individual options is assessed from first principles. The funding allocation process can be considered a top down process where the content of the sites plans are maintained but the timing of individual activities are flexed to meet a specific constraint such as funding. In this instance the Value Framework metrics are used to show the impact (positive and negative) of optimising against the constraint. Adding scenarios can then provide a national perspective.

An example of a scenario for the Magnox stations is shown in Figure 1

6. WHAT DOES THE VALUE FRAMEWORK MEAN FOR STAKEHOLDERS

Stakeholder input is essential to good decision making and the application of the Value Framework will not alter the basic options assessment processes that are used across the NDA estate, or alter the ability for stakeholders to engage with these processes. The only constraint that it will place on these processes is that it will fix the central evaluation criteria so as to ensure consistency at a national level. Figure 2 shows a typical optioneering process with stakeholders able to input to

screening criteria, and to drawing the attention of the decision makers to any wider considerations that needed to be taken account of before a final decision is made.

7. CONCLUSIONS

The conclusions from this work are:

- Metrics based on published literature, from reputable and credible sources, have been identified for environmental and safety attributes and these have allowed cash values to be assigned.
- A cost effectiveness approach to the value of hazard reduction has been adopted in line with experience of other contentious measures elsewhere in government.
- The value framework and supporting processes have been aligned with government guidance and integrated into NDAs wider business processes.
- The value framework does not reduce the ability of stakeholders to input to the decision making process, and the use of common and consistent metrics should in the longer term improve transparency and engagement rather than acting as a barrier.
- Implementation of the value framework should deliver the following benefits to NDA and its stakeholders:
 - The ability to make comparisons between different programmes of work and aid how the NDA prioritises between them on the basis of the value they deliver.
 - The structure and consistency to allow more devolved decision making.
 - A platform to support informed debate with stakeholders, the regulators and government on strategic and implementation (tactical) options, as well as funding allocation.
 - Clearer guidance to NDA's contractors on what NDA values, and therefore how they can engage with NDA to deliver this value, and produce robust business cases.
 - More efficient and targeted option development processes with focus on content rather than process.
 - Auditable output that allows NDA to underpin its proposals and decisions on level of spending and funding allocation.

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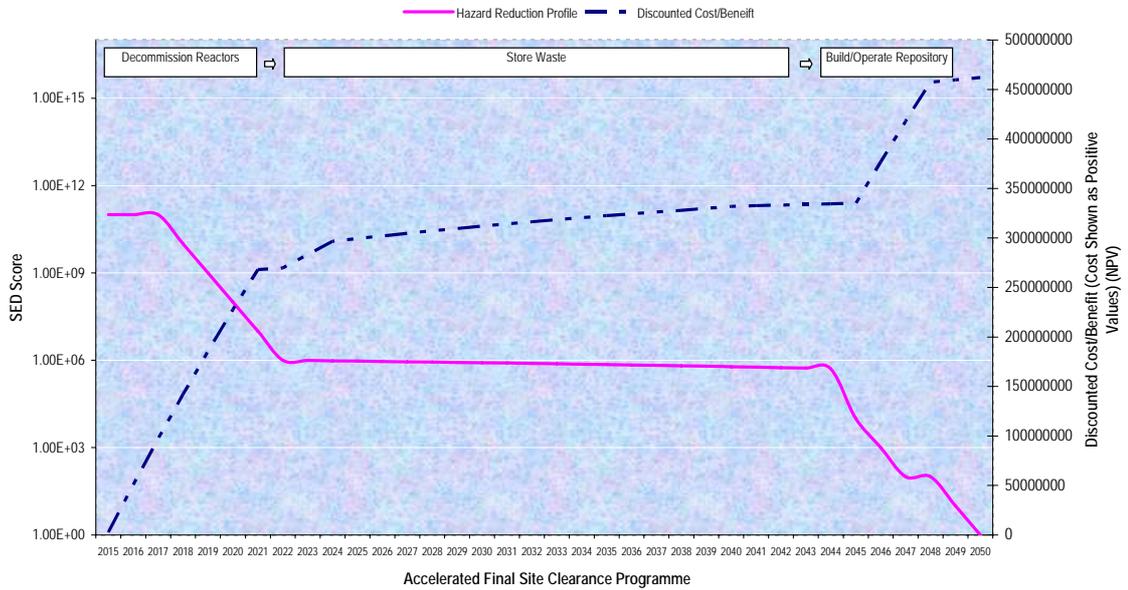
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NDA References and other information can be obtained from the NDA web site www.nda.gov.uk

FIGURE 1 – SCENARIO ANALYSIS SHOWING SED REDUCTION AGAINST COMBINED COSTS AND DETRIMENTS



Single Reactor Final Site Clearance Programme Analysis - Accelerated Version
 (Measure inc. Valuations of Discounted Nominal, Radiological Collective Dose & Operator Exposure, Employee Miles, CO2 Emmissions,)



Single Reactor - Final Site Clearance Programme Analysis - Base Case
 (Measure inc. Valuations of Discounted Nominal, Radiological Collective Dose & Operator Exposure, Employee Miles, CO2 Emmissions,)

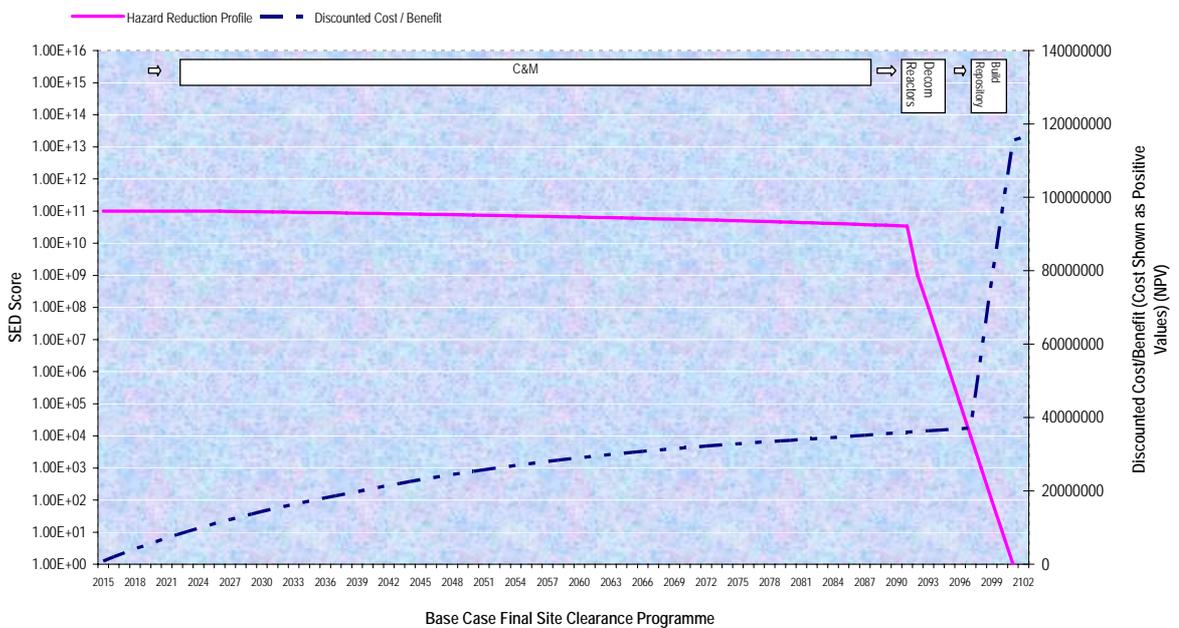


FIGURE 2 – OPTIONS ANALYSIS AND BUSINESS CASE DEVELOPMENT

