

## **Development of a National M&O Contractor Work Prioritisation Process and its Use as a Progress Measure for Nuclear Clean Up in the United Kingdom**

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### **ABSTRACT**

In July 2004, Her Majesty's Government established a Nuclear Decommissioning Authority (NDA) to assume responsibility for the discharge of the vast majority of the United Kingdom's public sector civil nuclear liabilities. The Energy Act of 2004 outlines in greater detail how the NDA functions, what its responsibilities are, and how these fit into the overall structure of the UK programme for managing and disposing of the liabilities created by a significant element of the UK's early commercial and nuclear weapons activities.

The amount of Government funding provided to the NDA will be a key factor in determining what can be achieved. In agreeing how the funds are distributed to the licensed sites, the NDA will need to keep in mind the 'guiding principles' stated in 'Managing the Nuclear Legacy – A Strategy for Action':

- Focus on getting the job done to high safety, security and environmental standards
- Best value for money consistent with safety, security and environmental performance
- Openness and transparency

To satisfy these requirements there is a need for a transparent process for justifying and prioritising work that aids decisions about what should be done and when, is straightforward to understand and can be applied by a wide range of stakeholders.

To develop such a process, a multi-stakeholder group (the 'Prioritisation Working Group') produced a report published in April 2005 that examined how the process would align with the NDA's overall management processes. It also identified six criteria or 'attributes' that should be taken into account, and a variety of measures, or 'metrics' that could be used to assess each attribute.

The report formed the basis of preliminary guidance from NDA to the site licensees that was used to guide their submissions on plans and programmes of work in 2005.

Since this report the NDA has been working, with stakeholder input, to develop a prioritisation process to be used during the production of future Life Cycle Baseline (LCBL) and Near Term Work Plan (NTWP) submissions.

This paper describes:

- The key attributes chosen to address the selection criteria important to various stakeholder groups;
- The methodology selected for ranking and weighing the relative importance of each proposed activity;
- The linkage between the decision-making processes at the national and site-specific levels with the NDA's annual planning cycles;
- The stakeholder engagement activities undertaken to ensure that the process will operate in an open and transparent manner;
- The proposed methods by which this process will not only assist in the early selection of the highest priority work, but also will facilitate the annual management of the portfolio of activities being performed at each site; and
- The status of actions to institutionalise these processes into the formal procedures for future NDA work planning and progress measurement.

Further information can be obtained from the NDA website [www.nda.gov.uk](http://www.nda.gov.uk)

## INTRODUCTION

The Energy Act, and the Nuclear Decommissioning Authority (NDA) Management Statement and Financial Memorandum, places requirements on the NDA in respect to performance reporting, openness and transparency, and for ensuring that the rationale for major decisions, and the processes by which they are reached, are clear to stakeholders and the wider public. One of the ways in which the NDA can achieve this is by development of a process for work prioritisation which can be used by the Site Licence Companies (SLCs) in the development of their life cycle baselines for individual sites, and applied at a national level by the NDA to determine how money is allocated between sites, and to measure delivery of the NDA's mission.

## THE PRIORITISATION WORKING GROUP

In 2004 a working group, the Prioritisation Working Group (PWG) was set up to assist with the development of the prioritisation process. This group was made up of a wide range of stakeholders including the nuclear, security and environmental regulators, representatives from the green movement, local authorities, and the SLCs. This group published a report in April 2005 [1], the key points being:

It was agreed that prioritisation should only be applied to clean up and remediation activities as commercial operations are covered explicitly within the energy act.

They identified six main factors (**Attributes**) that they believed should be considered when determining what should be done first. These factors or attributes are:

- Reducing the ability to cause harm posed by the nature of the material located within a given facility or structure. This is termed **Hazard Potential Reduction**.
- The condition of the storage facility with respect to design life, how well maintained it is, its defense in depth, and whether the stored material is deteriorating. This is termed **Safety and Security Management** and is closely related to risk.

- **Value for Money** is the overall net benefit of doing a specific activity or package of work.
- **Advancing the Programme** is getting on with the job.
- The impact on the environment of the facility or waste simply by being there is the environmental mortgage. This is termed **Environmental Factors Management**.
- Social issues is the impact, adverse or otherwise, that a specific activity or package of work is likely to have on the communities local to where the work will be performed. This is termed **Socio-Economic Issues**.

They identified a wide range of possible metrics that could be used to measure how a specific activity, or package of work, performed against each of the individual attributes. However, no agreement was reached on how the metrics and attributes could be combined to determine a prioritisation, other than as a starting point all the attributes should be considered equally important.

Following issue of the PWG report work has been on going with the PWG to rationalise the metrics, and to determine how they can be combined to score individual attributes, and how the attributes can be combined to determine a ranking for specific activities or packages of work. This work has generated some key decisions that have led to the current form of the prioritisation process, these are:

- The process should focus on, and measure, the underlying benefit of doing a package of work rather than the issues around doing the work ie divorcing how from why as the how is addressed by the normal regulatory processes eg BPM, ALARP etc.
- The means of measurement of any attribute or metric should incentivise the right behaviours within the industry ie dealing with the high hazard old plants that have high impact on the environment first, in a timely and cost effective manner.
- There are no direct measures for socio-economic factors as these vary depending on local circumstances and the politics of the time. Therefore to provide measures may generate adverse behaviours eg prolonging site closure to maintain local jobs. Therefore it was agreed that this should be evaluated in a subjective manner once other attributes have been taken account of. Therefore this attribute was noted as being a **Modifier**.
- Rationalisation of the Advancing the Programme metrics meant that this attribute reduced down to being about changing sky line and being seen to be making progress. As the need to do this is a political issue it was viewed that this should be treated in the same way as socio-economic issues.
- The prioritisation process should tie in with other systems being used by the regulators, and where practicable common approaches and metrics should be used. This would prevent re-inventing of wheels and reduce the workload on the SLCs, as well as promoting a common understanding and language to aid future communications.
- The process must recognise the responsibility of the site license holders to determine how and in what order work is done on the sites for which they are responsible, whilst also accepting that the NDA has a responsibility to prioritise how money is spent at a national level.

- The process must generate an output that can be used to make comparisons within sites, between sites, and at a national level. The best analogy to this is an accountancy system where the rules are laid down corporately but the application is done at the local level.
- The process is an aid to decision making, and provides the first steps in an audit trail. The process does **not** make decisions but is used to inform scheduling of work.

## PROCESS DEVELOPMENT

The work of the PWG identified three basic questions that the prioritization process needed to be able to answer these were:

- Based on what is known today and just analyzing the basic attributes of individual facilities which would you look to address first?
- Based on the declared strategies, timescales and costs for remediation of individual facilities or inventories, which projects provide the best overall return on investment?
- What does success look like?

Examining these questions lead to the conclusion that the process required two different sets of measures, one which focuses on the basic attributes of individual facilities and can be used to assess the status of a facility at different points in time, the other which makes an assessment of the value delivered by a particular package of work in terms of time and money. These two different measures were:

- **Plant Status** - The process for measuring progress based on assessing the year by year improvement in the hazard, safety, and environmental attributes for individual facilities and summed up to provide a site wide picture.
- **Project Benefit** - The process for determining the order in which packages of work should be performed based on the overall benefit derived from performing the package of work, balanced against the cost and timescales over which the benefit is achieved.

### Development Of Plant Status Measure

The plant status measure is a point in time assessment therefore of the six attributes identified by the PWG only three were considered to apply:

- Hazard Potential
- Safety and security management
- Environmental factors management

The next stage was how should these be measured, and how should they be combined to provide an overall score. For hazard potential a measure has already been developed within the UK nuclear industry, this is the Hazard Indicator [2] (HI). It was also accepted that compliance with security requirements is a statutory obligation and hence forms part of the overall work that must be carried out on a site for it to remain legally compliant. Therefore the safety and security attribute reduced down to safety management where this could be assessed using the system developed by the Nuclear Installations Inspectorate [3] (NII). A range of metrics was identified

by the PWG for environmental factors management but these have not been finalised with the environmental regulators at the present time.

Having identified a set of metrics the next stage of the process was how to combine them. Fig. 1 shows a graph of Hazard Potential against Safety Management for individual facilities. Clearly the facilities that need to be addressed first are those that have high scores for both factors i.e. those in the top right hand corner. The problem is that Hazard Potential numbers may vary by many orders of magnitude between facilities compared to Safety Management, also the question arises 'is high hazard more significant than high safety'. Examination of this issue against a range of UK facilities has resulted in the following scoring system:

$$\text{Status Measure} = (\text{Hazard Potential}) \times (\text{Safety Management})^4 \times (\text{Environmental Factors})^x$$

### Where

$$\text{Hazard Potential} = (\text{Hazard Indicator})$$

$$\text{Safety Management} = (\text{NII metric for facility condition} \times \text{NII metric for waste uncertainty})$$

$$\text{Environmental Factors} = (\text{Environmental Factors yet to be determined by the Environment Agency (EA) and the Scottish Environmental Protection Agency (SEPA)})$$

Progress is predicted by re-calculating the plant status measure on a year by year basis, assuming that the site implements its agreed schedule of work, and can be treated in a similar way to classic cost and schedule performance metrics (Fig. 2).

### Development Of Project Benefit Measure

To understand project benefit the first thing that needs to be defined is what is the project that is being assessed. This resulted in the concept of **Primary Project** being developed, where the primary project is all the work that needs to be undertaken to transform an inventory from its current condition to a better condition. The diagram in Fig. 3 best illustrates this.

The power of this concept is that it ensures that all the work to remediate a particular inventory gets the same priority so that the work moves forward in unison. To some extent it does not matter where the SLCs draw the project boundaries provided they are logical and clearly documented.

Four of the attributes identified by the PWG can be considered to contribute to the project benefit measure and these are considered to be of equal value as follows:

$$\text{Project Benefit} = (\text{Hazard Reduction Potential}) + (\text{Safety Management}) + (\text{Value For Money}) + (\text{Environmental Factors})$$

**Where**

Hazard Reduction Potential = (Change in Hazard Indicator (HI) compared to project duration)

Safety Management = (The Nuclear Installation Inspectorates (NII) metrics<sup>(3)</sup> for the condition of the facility, the uncertainty to what is happening with the waste, and the reduction in the mortgage dose uptake to operators by doing the project compared to project duration)

Value for Money = (The reduction in hazard indicator as a result of the project compared to the project cost + the change in the underlying facility costs as a result of the project compared to the project duration)

Environmental Factors = (Change in environmental Factors compared to project duration)

In each case each metric scores from a 100 points and then the score for each attribute is divided by the number of metrics. This ensures that all attributes remain equally weighted independent of the numbers of metrics used.

Having identified the means of combining the metrics and attributes the question remained how do you score the metrics. In the case of the safety management metrics these were considered not to change over the life of a project, as this removes the incentive to try to shore up the facility rather than address the root cause. Therefore the NII metrics [3] can be used.

In the case of the other metrics it is a value judgment as to what represents impressive performance, what is good performance, and what is uninspiring. This, with the assistance of members of the PWG, has lead to the generation of a series of scoring tables an example of which is shown in Table I.

Table I. Reduction Hazard Indicator Compared to Project Duration

<b>reduction = <math>\log(H_1 -</math></b>	-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	-4	50	38	25	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	-3	60	48	36	24	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	-2	70	60	50	40	30	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	-1	80	72	64	56	48	40	32	24	16	8	0	0	0	0	0	0	0	0	0	0	0	0	0	
	0	90	83	77	70	64	58	51	45	38	32	26	19	13	6	0	0	0	0	0	0	0	0	0	
	1	100	95	89	84	79	74	68	63	58	53	47	42	37	32	26	21	16	11	5	0	0	0	0	
	2	100	96	92	88	84	80	76	72	68	64	60	56	52	48	44	40	36	32	28	24	20	16	12	8
	3	100	100	97	94	90	87	84	81	78	74	71	68	65	61	58	55	52	48	45	42	39	36	32	29
	4	100	100	97	94	92	89	87	84	82	79	77	74	71	69	66	64	61	59	56	54	51	48	46	43
	5	100	100	100	98	96	94	92	90	88	86	83	81	79	77	75	73	71	68	66	64	62	60	58	56

6	100	100	100	98	96	95	93	91	89	88	86	84	82	81	79	77	75	74	72	70	68	67	65	63
7	100	100	100	100	99	97	96	94	93	91	90	88	87	85	84	82	81	79	78	76	75	73	72	70
8	100	100	100	100	100	99	98	97	95	94	93	92	90	89	88	86	85	84	83	81	80	79	77	76
9	100	100	100	100	100	100	99	98	97	95	94	93	92	91	90	89	88	87	85	84	83	82	81	80
10	100	100	100	100	100	100	100	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84
11	100	100	100	100	100	100	100	100	100	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86
12	100	100	100	100	100	100	100	100	100	100	100	100	99	98	97	96	95	94	93	92	91	90	89	88
13	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	98	97	96	95	94	93	92	91
14	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	98	97	96	95
15	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	98
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>Primary Project Duration (Years)</b>																								

## ROLES AND RESPONSIBILITIES

For the prioritisation process to work, and to ensure compliance with statutory requirements, it is essential that the roles of the NDA, the regulators, the stakeholder community, and the SLCs are clearly defined. These are as follows:

### NDA

- To provide and maintain a common approach to prioritisation across the UK.
- To audit that the rules for prioritisation and progress measurement are being applied consistently by the SLCs across the UK and to promote good practice in application of the process.
- To identify ranges of funding scenarios for individual sites for use by the SLCs in determining overall schedules of work.
- To evaluate the schedules of work proposed by the SLCs based on the site funding scenarios and to use the progress measurement data in consultation with the regulators and national stakeholders to determine how available funds are allocated between sites.

### Site Licence Company at Site Level (SLC)

- To apply the prioritisation process at site level based on the NDA prescribed system.
- To be the 'Controlling Mind' and determine in what order work should be performed on their site to meet the requirements of the site funding limits set by the NDA and to maximise the rate of progress as measured by the NDA progress measures.
- In determining the order in which work should be performed to consult with the regulators and local stakeholders to ensure that their views are taken account of, and to modify work priorities where it is appropriate to do so.

### Regulators and Other Stakeholders

The role of the regulators and other stakeholders are as consultees in determining the order in which work is performed. This consultation may be the justification for the application of specific modifiers.

## PRIORITISATION PROCESS

Fig. 4 provides an overview of the overall process. Prioritisation can be considered to consist of four basic steps:

### Step 1

This assesses the current status of individual facilities using the plant status measure.

This represents the prime drivers for remediation, and links with the NDAs mission to reduce the hazards, risks, and environmental impact posed by the UKs civil nuclear legacy. Table II shows the results of the process for the facilities shown in Fig. 1, based on status measure but excluding the environmental factors attribute.

Table II. Selection of UK Plants

Rank	Plant	Site	Status Measure	Comments
1	A	A	$3.16E^{+27}$	
↓	B	B	$6.15E^{+22}$	Plants B and C are comparable in that C has lower hazard than B but the building condition is worse.
	C	A	$1E^{+22}$	
	D	A	$1.6E^{+20}$	D is below C and B because although it has an very hazardous inventory the facility is considered to be in a lot better condition.
	E	C	$2.04E^{+14}$	
	F	B	$6.55E^{+13}$	
	G	D	$1.0E^{+6}$	
	H	E	$1.0E^{+5}$	

### Step 2

This involves the SLCs identifying the projects (**Primary Projects**) required to address the individual inventories starting with those in the highest ranked facilities. In all cases the project should encompass all the activities, including R&D, to take the inventory from its current condition to a better condition. This ensures that all the enabling activities have the same priority and move forward together.

### Step 3

The SLCs assess the individual projects based on the overall improvement they deliver with respect to hazard, risk, and environmental factors compared to the cost and time expended to deliver the improvement. This allows the projects within a site to be ranked on the overall benefit they deliver, and allows analysis of whether the strategies for high hazard, high risk plants are optimised.



#### **Step 4**

The SLC develops the NTWP/LCBL schedule to meet the requirements of the site funding constraints. Scheduling takes place in the following order:

- Address all legal requirements
- Projects on the basis of overall benefit, those that deliver most benefit being scheduled first but taking account of logistical, regulator, and stakeholder requirements.

The result of this step is a LCBL/NTWP schedule for a site that has been produced to maximise the rate of progress in terms of reducing hazard, risk and environmental impact, but has then been modified to take account of specific regulator or stakeholder requirements. Where the programme has been modified to take account of such requirements then these changes are documented and justifications provided as to why it is reasonable and appropriate. An example of a modification could be to make a big visual statement of progress by changing the skyline or by de-licensing an entire site.

#### **HOW DOES NDA USE THE INFORMATION**

The information from the prioritization process is used in the following ways by the NDA:

- To measure progress on individual sites in terms of increasing the passivity and conditions of storage of waste (Fig. 5).
- To provide a means of getting the SLCs to focus on 'Doing The Right Thing'. The best programme for a facility or site will be the one that produces maximum reduction of the progress measure in the shortest time, and at the lowest cost.
- To compare investment decisions. Based on the information in Fig. 5 and the status information for Plant G from Table II it is unlikely that this project would receive additional funding.
- To analyse the impact of applying different site funding levels to individual sites in terms of the effect it has on the rate of progress. This may then be used to make decisions on how funding is allocated between sites.
- To communicate decisions by providing an audit trail through the decision process.

#### **COMPARISON WITH REGULATOR SPECIFIC PRIORITISATION SYSTEMS**

The regulator specific prioritization systems focus on what is important to each individual organisations and are intended to assist their own inspectors in making decisions. An example of such a system is the NII system<sup>(3)</sup> which is also being presented at this conference, but similar systems are also being considered by the environmental regulators. These systems take account of some of the issues that are important to other stakeholders but this is not their primary purpose.

In contrast the NDA system has to take account of a wider spectrum of stakeholders and try to balance the competing interests whilst presenting a national picture. Because of this there is a potential for tensions to develop regarding what needs to be done and the timescales over which

it is achieved. By ensuring that the systems are all developed around a common data set and language, where differences arise the causes can be discussed and a consensus reached on the best way forward.

## **WAY FORWARD**

The prioritization process, as presented in this paper, meets the objectives of providing a process for communicating with stakeholders, underpinning decisions in an auditable manner, and providing a means of measuring progress with respect to 'Doing The Right Thing'. The next stage of the process is to complete the development of the Environmental Factors metrics, and to test the system during the production of the next LCBL/NTWP submission which is due in March 06. It is anticipated that following this testing some learning from experience will need to be included prior to the system going 'live' in September 06 to support production of NTWP/LCBL 07.

## **ACKNOWLEDGEMENTS**

It would not of being possible to develop the NDA prioritisation process without the support and contributions from a wide range of stakeholders and other organizations. In particular:

- The members of the Prioritisation Working Group
- The Site License Companies
- Gregg Butler and Grace McGlynn of Integrated Decision Management
- Stephen Knight and William Pearson of React Engineering
- Steve Robinson of Environmental Business Management

## **REFERENCES**

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3. P. Connolly, P. Addison, Her Majesty's Nuclear Installation Inspectorate, The Approach of the United Kingdom's Nuclear Installations Inspectorate to Prioritisation of the Work Associated with the Remediation of the UK's Nuclear Liabilities., WM'06 Conference, February 2006, Tucson, US.

## **FURTHER INFORMATION**

Further information can be obtained from the NDA website [www.NDA.gov.uk](http://www.NDA.gov.uk)



Fig. 1. Hazard posed by waste compared to conditions of storage and knowledge of waste form

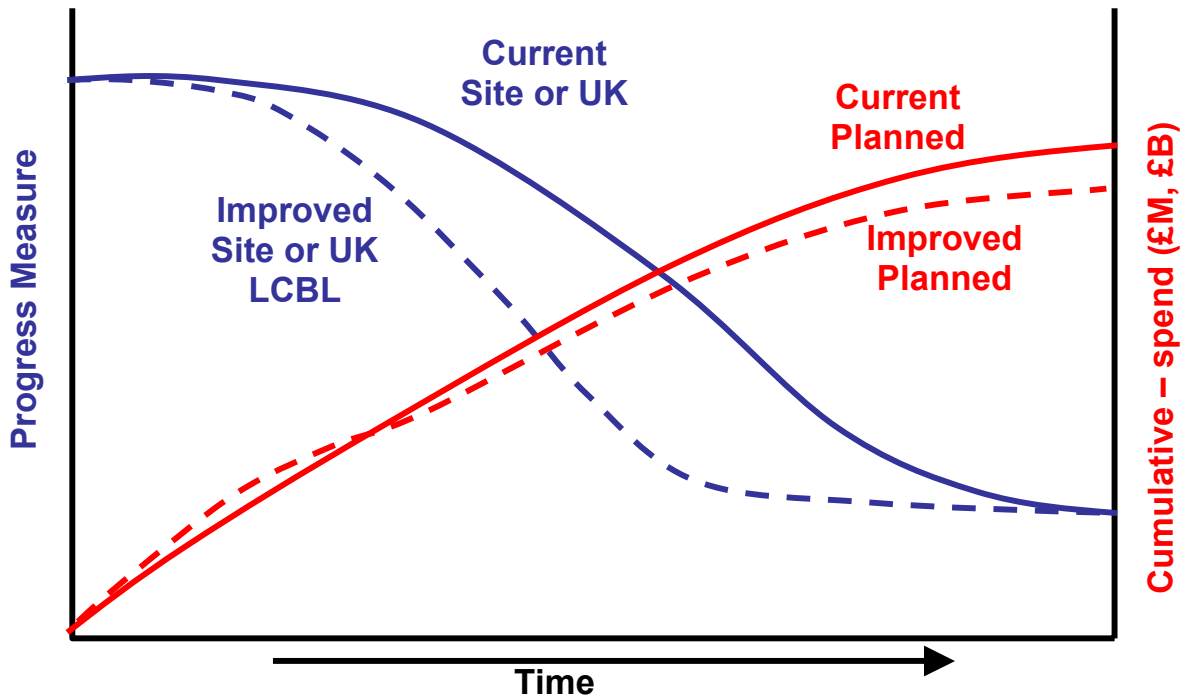
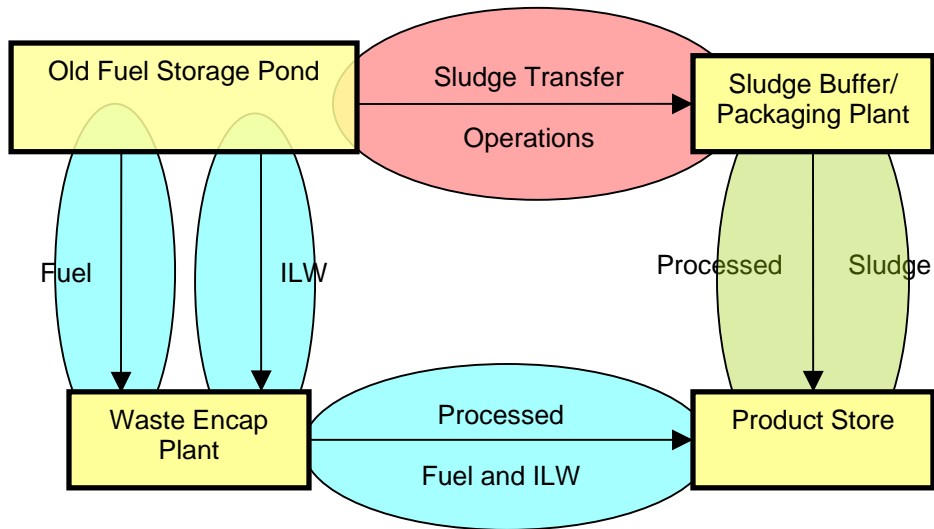


Fig. 2. Generic example of progress measure



For the fuel pond there are potentially five ways of defining a Primary Project.

1. Transfer sludge from pond to Sludge Buffer
2. Process sludge and transfer to product store
3. Transfer sludge and process through the product store as single project.
4. Transfer fuel and ILW through encapsulation plant to product store
5. Remove all inventory and transfer to product store as single project

Fig. 3. Primary project

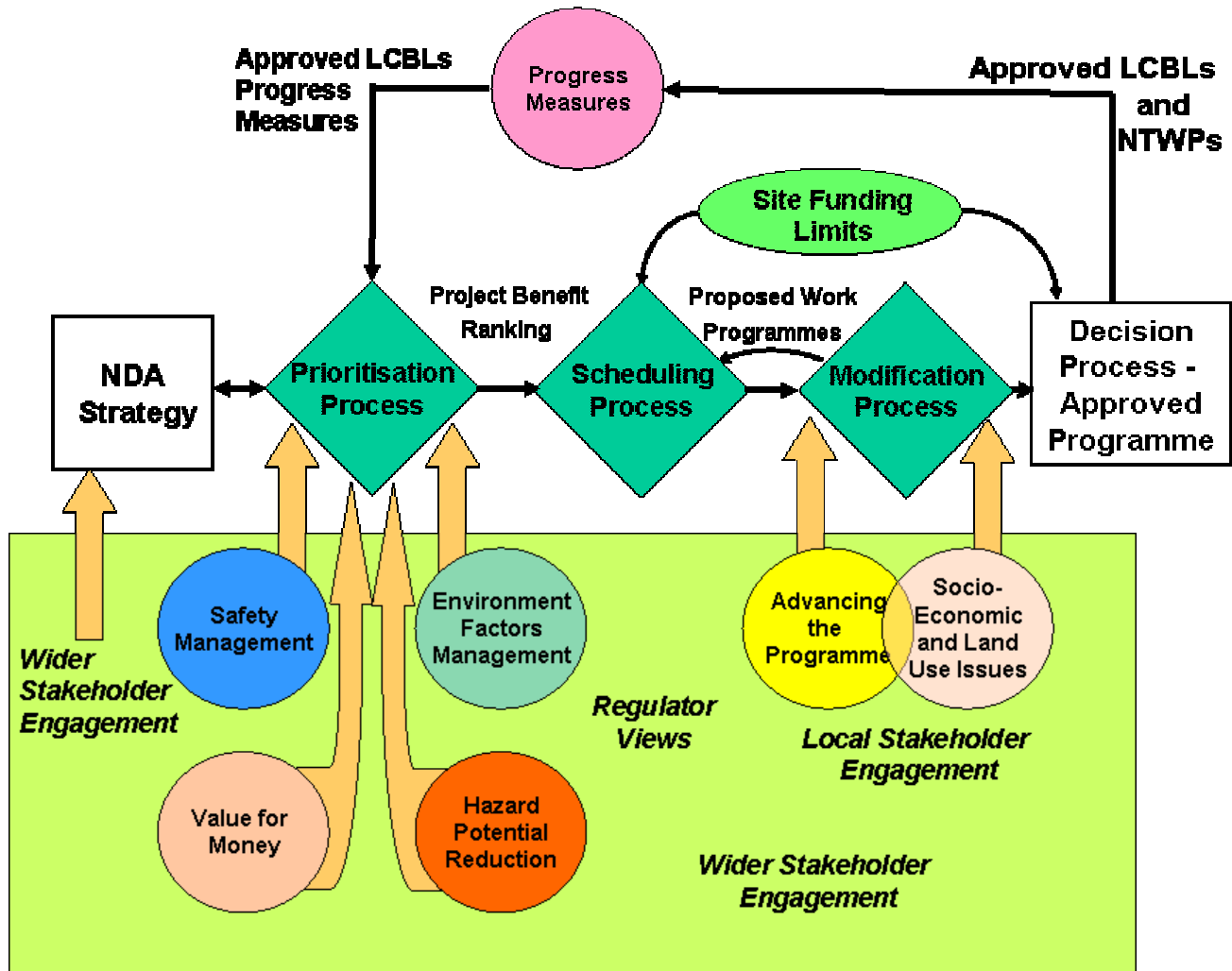


Fig. 4. Overview of prioritisation process

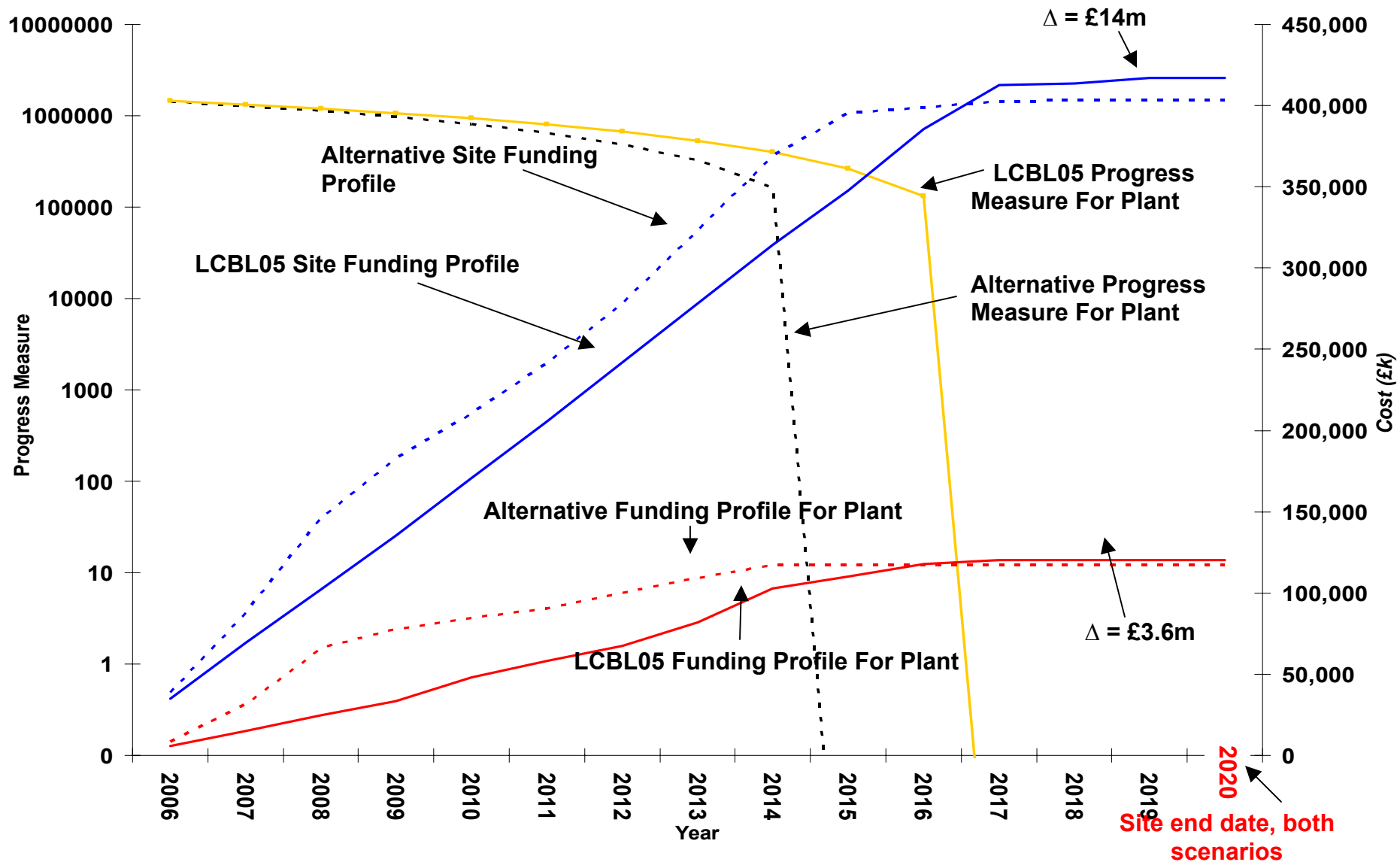


Fig. 5. Example of application to a real site and project