

Development of the Integrated Programme for the Cleanup of the Sellafield

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ABSTRACT

The Sellafield site in the United Kingdom is highly complex and integrated site. It has two operating reprocessing plants, a fuel fabrication facility and significant processing facilities for the conditioning of high level, intermediate level and low level wastes. It plays a major role in supporting the UK nuclear generation and dealing with the legacy from the early nuclear programmes. Sellafield also supports a number of international nuclear programmes.

The UK nuclear industry is undergoing an intense programme of change with many nuclear facilities coming to the end of their lives, new reactors being discussed and a different organisational structure for running the UK nuclear programme. Common to all of this is increased determination to decommission and cleanup historic nuclear wastes.

The challenge for the site has been how to put together a cleanup programme for the site whilst recognising the ongoing international strategic value of many of the facilities on the site. The work to produce an integrated plan for Sellafield is now complete and extends from the detailed consideration of facilities and processes through to socio economic impact on the local community. Extensive use has been made of operational research tools and strategic models that cover costs, resources and technical aspects for over 300 active facilities, and over 1000 waste streams. Key strategic decisions facing the site have been analysed and decision calendars produced. These illustrate the options available for each strategic decision and the latest date by which decisions can be taken. Many of the most significant decisions affecting the site need to be progressed within the next few years. The paper describes the process by which the integrated plan for Sellafield has been produced, some of the tools and techniques used in analysing them and the key decisions facing the site.

INTRODUCTION

The Sellafield complex is one of the most complex and compact nuclear facilities in the world. It consists of three reprocessing plants (two operational, one undergoing decommissioning), one MOX fabrication plant and seven reactors, (undergoing defueling or decommissioning) (operational). In association with these major processing plants there are over 350 nuclear facilities, 600 major effluent streams and over 1200 waste routes. These facilities have been constructed over several decades and highly interdependent, over 60% support more than one of the sites high level objectives. The Sellafield site is on the edge of the Lake District National Park, an area of outstanding natural beauty. It is compact, only 4 square kilometers and in many cases operational plant and pipebridges are only meters away from redundant facilities which

must be decommissioned and demolished. The site is both a major asset to the UK and its major source of nuclear liabilities, over 80% of the UK nuclear material is stored on the site.



Figure 1 Sellafield Site

The mission for the Sellafield site has evolved over many decades from its origins as a facility for producing material for nuclear weapons in the early 1950s and 60s through support to a UK

civil nuclear power programme in the 1960s and 70s to an international nuclear service provider from the 1980s. It has now reached one of the most interesting and most complex phases of its existence and one which is characterized by change, uncertainty, challenges and opportunities not just in terms of the UK but challenges which are familiar to many across the international nuclear community. The challenges facing the site include:

- Ageing nuclear facilities with legacy nuclear material in urgent need of decommissioning.
- Major ground and ground water contamination.
- Significant inventories of a wide variety of nuclear wastes.
- Significant change in organizational structures within the UK nuclear industry.
- Historic uncertainty in political direction for the UK nuclear industry.
- Future opportunities from a renaissance of the nuclear industry worldwide.

The challenge for the site has been to construct an integrated strategy for the site which has wide stakeholder and regulator support but which also recognises that there are uncertainties and key decisions which affect the future of Sellafield that remain to be resolved.

REQUIREMENT OF AN INTEGRATED STRATEGY FOR SELLAFIELD

The newly formed Nuclear Decommissioning Authority (NDA) in the UK has recently taken on accountability for all civil nuclear liabilities in the UK. The NDA strategy states:

“Our mission is to deliver a World class programme of safe, cost – effective, accelerated and environmentally responsible decommissioning of the UK’s civil nuclear legacy in an open and transparent manner and with due regard to the socio-economic impacts on our communities.”

“We also recognize our responsibilities to ensuring our commercial assets are operated effectively and efficiently and to maximize the revenue from these plants to offset the costs of decommissioning and clean-up.”

NDA require each site licensee to produce a Life Time Plan for their site , however, they recognize that there are still outstanding socio political issues which still remain unresolved in the UK which impact on the plans for the site. These include:-

- The final disposition of civil UK plutonium.
- The final disposition of uranium.
- The timing and location of a repository for the disposal of intermediate and high level wastes.
- The disposition of UK spent fuel.
- The required end use and end state for each of the UK nuclear sites.

As a result an integrated strategy for Sellafield has to recognise that there are significant decisions yet to be taken so that the Strategy must be both flexible yet sufficiently directive to allow progress to be made despite these uncertainties. The integrated strategy for Sellafield also has to address the requirements of many stakeholder some of which have mutually exclusive requirements. These include NDA, Government, Regulators, non governmental organisations, trade unions, local communities, supply chain,

international communities and most importantly our workforce. A successful strategy for Sellafield is therefore one which:

- Illustrates the choices and consequences of decisions affecting the site.
- Illustrates the timescales when decisions have to be taken and is robust to changes in direction.
- Considers risks and uncertainties.
- Has been analysed in sufficient detail so that it has a high probability of success.
- Can be communicated easily and simply so as to facilitate ongoing stakeholder engagement.
- Clearly articulates site priorities and the use of scarce resource.

If an integrated strategy has been well produced it has the following features.

- It covers all facilities, on the site all nuclear material and all effluents.
- It considers all options on the disposition of nuclear material and wastes.
- It considers all constraints to the delivery of a successful strategy such as costs, affordability, people, experience, supply chain availability, technology availability, discharge limits and nuclear knowledge.
- It provides clear priorities which are supported by government, NDA and Regulators.
- It has been assessed at a level of detail which ensures the strategy can be delivered.
- It is adaptable to changes of circumstances and is 'kept live'.

If the strategy is not robust it will result in lack of regulatory and stakeholder support which in turn leads to increased intervention by regulators and increased scrutiny by NDA.

THE PROCESS FOR DEVELOPING THE INTEGRATED STRATEGY FOR THE SITE

The integrated strategy for Sellafield has been developed over the last 18 months by the site licensee with the support of NDA and regulators. External stakeholders have also been consulted. The key steps in the process were:

- Identification of the high level objectives for the site and the strategic options available to meet these objectives.
- Evaluation of the options, including detailed analysis and assessment (with the aid of business and technical models where appropriate).
- Consultation with regulator and stakeholders on the strategic options.
- Deselection of strategic options.
- Integration of the remaining strategic options and extensive scenario modeling.
- Selection of the recommended integrated strategy for the site.
- The identification of key decision calendars.
- The assessment of contingent strategies.

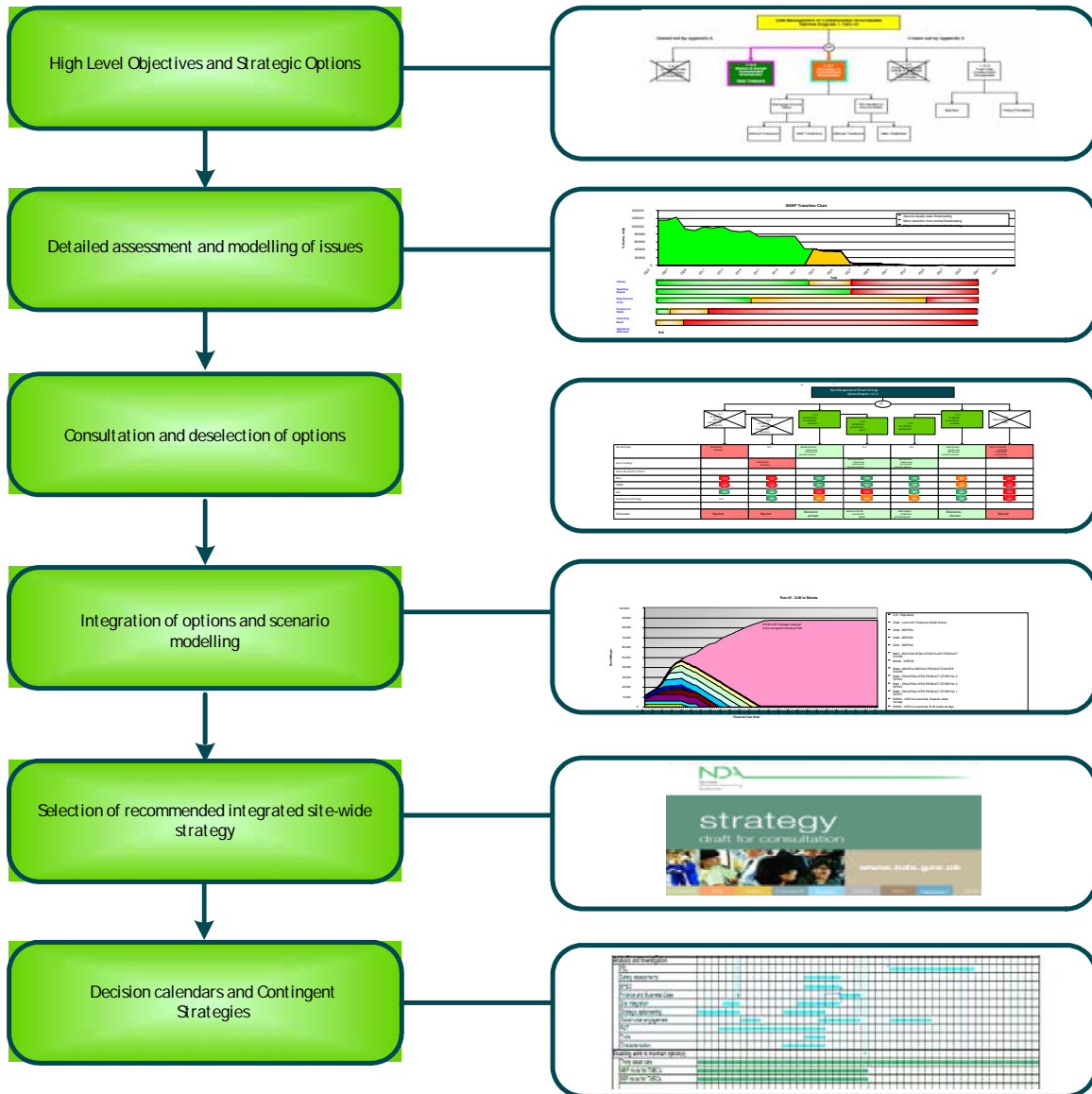


Figure 2 Process for producing an integrated strategy for Sellafield

The strategy is supported by a site wide strategic model which covers costs, resources, all facilities, all wastes, all effluents and all discharges. Supporting the site model are more detail operational research and stochastic models for analyzing complex interdependent issues, these include retrieval projects, effluents, transport, stores, fuel pond inventory management and high level waste inventory management.

KEY FEATURES OF THE INTEGRATED STRATEGY FOR SELLAFIELD

As part of developing the integrated strategy for the site, a greater understanding of the issues facing Sellafield site has been made visible, which in turn has helped inform NDA in formulating the strategy for managing the nuclear legacy for the UK. Some of the key findings from the strategy for Sellafield are:

- The priorities for the site are the rapid reduction of hazard potential at Sellafield. This includes the reduction of Highly Active Liquor stocks to buffer levels by 2015, the completion of Magnox reprocessing and the removal and treatment of legacy wastes. In overall terms, 99% of the hazard reduction is achieved for around 25% of the cleanup costs for the site.
- Ongoing commercial operations on the site are an important part of ensuring ongoing funding for cleanup projects. There are opportunities for further commercial operations at Sellafield to the benefit of the cleanup programme.
- Resource management is key to ensure effective delivery of the cleanup strategy for the site. This includes employees of the Site Licence, Company specialized services provided by the supply chain, and effective deployment of scarce nuclear knowledge, skills and experience.
- The decommissioning programme must be considered alongside the programme for waste handling and waste management. This is influenced by the timing and availability of a repository for intermediate level waste.
- There are limited benefits of broad-front decontamination for the more radioactive facilities on the Sellafield site. The benefits that extensive decontamination brings needs to be offset against the issues that arise in managing the associated effluents and secondary wastes.
- The site has an extensive integrated effluent management system and site infrastructure. It is extremely important that all upstream processing of nuclear material and wastes, including wastes generated from the early stages of decommissioning are completed before the integrated effluent systems are taken out of service and subsequently decommissioned.
- The UK commitments to the Oslo and Paris Agreement on discharges to marine environments can be met.

Over the next few years a number of key decisions must be made which will define the role that Sellafield will play in shaping the future of the UK nuclear industry. These are included on an executive decision calendar for the site which identifies the various roles of the site licensee, the Nuclear Decommissioning Authority, government and the regulator in ensuring that the right decisions are taken on a timely basis. These strategic decision calendars are an important part of governance at the Sellafield site and help ensure that associated projects and operational programmes are well directed and proceed to schedule. Key policy decisions that impact on decisions of the site include:

- Future plans for Thorp.
- The role for Sellafield in support of any new build programme.
- Any role for Sellafield in managing wastes from across the UK.
- The role for Sellafield in the ongoing storage and final disposition of any nuclear fuel which is not envisaged to be reprocessed.

IMPACT OF THE INTEGRATED STRATEGY ON THE SCHEDULE FOR DECOMMISSIONING AT THE SELLAFIELD

As part of developing the integrated strategy for the site, both the programme and the techniques proposed for decommissioning were re-examined so as to take into account the availability of waste routes, waste storage capacity, the rate of reduction of hazards, the availability of effluent routes, the requirement for access into confined areas of the site, the need to gain access to contaminated land and the anticipated level of funding. The following changes were made:-

- More extensive use of plant washouts is made after the plants are shutdown including the possible use of exotic chemicals to target mobile solids and sludges. This makes best use of centralized site effluent and associated waste management facilities whilst they are available.
- The programme now makes extensive use of 'hold points' in decommissioning to allow facilities to be taken to the point where mobile nuclear material has been removed, the safety case can be simplified, the level of support required from the site infrastructure is reduced, and the care and maintenance cost can be reduced in line with the new situation.
- The schedule of facilities undergoing decommissioning together with the use of hold points allows resources to be more effectively deployed and provides continuity for scarce resources from the supply chain. It also allows the decommissioning programme to be 'flexed' according to funds available to NDA.

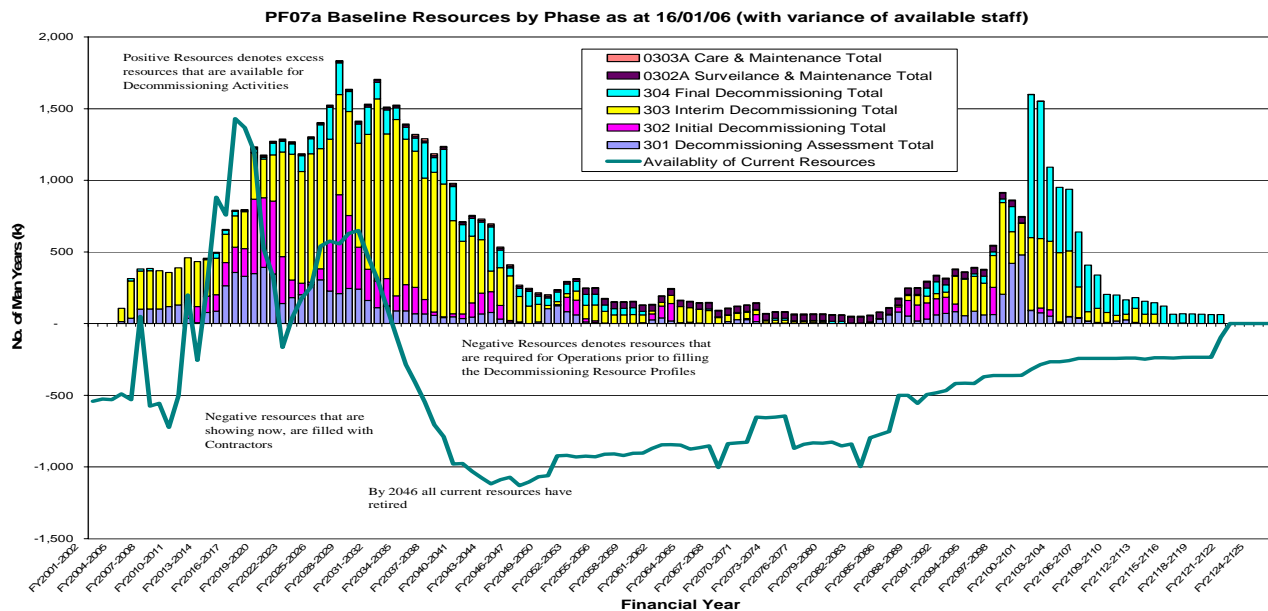


Figure 3 Examples of key finding decommissioning

- Extensive use of modelling together with the use of 2D and 3D visual representations of the changing status of buildings, services, waste routing and use of land at Sellafield helps ensure that decommissioning is planned at a level of detail that avoids conflicts and mistakes being made.



Figure 4 GIS of Sellafield site in 2025

SUMMARY

An integrated strategy for the Sellafield site has been produced with the support of the Nuclear Decommissioning Authority (NDA) and regulators which gives increased confidence in delivery of NDA's mission of safe, cost effective and environmentally responsible for cleanup of the nuclear legacy at the Sellafield site. A high level programme of key decisions facing the site has been produced which identifies the roles of the site licensee, the Nuclear Decommissioning Authority, government and regulators. This is an important component of exercising governance on the site. It also facilitates stakeholder engagement on key issues.

Extensive use has been made of modeling of activities on the site as a whole, and complex interactions within the site so as to improve the quality of analysis of key issues facing the site. This improves the

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quality of the Life Time Plans and gives increased confidence in the decommissioning programmes for the site. These models are an investment for the lifetime of the Site and will be maintained for as long as complex interactions across the site require analysis.