RESTORING THE DOUNREAY SITE – THE WAY AHEAD

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ABSTRACT

The Dounreay site, on the north coast of Scotland, is UKAEA's largest and most complex site with three former nuclear reactors and a range of fuel cycle facilities and research laboratories. This year UKAEA launched the Dounreay Site Restoration Plan (DSRP), which presents proposals for the completion of the complex and challenging task of restoring the Dounreay site within 60 years, including the removal of all significant radioactive hazards within 25 years. The Plan was formally presented to the regulators in September 2000.

The DSRP is the first example in the UK of a detailed blue print for the total restoration of a major nuclear site of this kind. Restoration encompasses the decommissioning of all facilities, the management of all waste, both historic and that which will arise from decommissioning, and the remediation of contaminated land. For the next 60 years UKAEA at Dounreay will be focussed solely on the delivery of the DSRP. All business processes are being tailored to achieve this goal. Put simply, the DSRP is the strategic business plan for the site, and UKAEA will be judged by regulators, government and the public against its progress in delivering this plan.

This paper describes the methodology used to assemble the Dounreay Site Restoration Plan, summarises its content and explains how business processes are being aligned towards delivery of the associated programmes of work.

INTRODUCTION

The Dounreay site, on the north coast of Scotland, was chosen by the UK Government in the 1950's as the centre for Britain's Fast Reactor Development Programme. In 1955 the United Kingdom Atomic Energy Authority (UKAEA) acquired most of the land within a 1.6km radius of the site and started construction of the Dounreay Fast Reactor (DFR), the Dounreay Materials Test Reactor (DMTR) and their ancillary fuel cycle plant and facilities. These included fuel manufacture, waste management and laboratory facilities. This was followed by the construction of the larger Prototype Fast Reactor (PFR), which operated successfully until its closure in 1994.

Until the closure of PFR, the mission at Dounreay was that of a pioneering research and development establishment. Now the UKAEA's mission at Dounreay is to restore the site through decommissioning the facilities, managing the associated wastes and remediation of the land. Restoring the Dounreay site is expected to take 40 – 60 years at a cost of around £4 billion, and as such represents a major challenge for the future. As the site operator, UKAEA is responsible for delivering this programme safely, environmentally responsibly and in a cost-effective manner.

The transition from an R&D establishment to one focussed on environmental remediation has necessitated a number of major organisational and structural changes at Dounreay, including the divestment of non-core activities and an increasing use of contractors. Also during this period a number of high profile events occurred at Dounreay, including the temporary loss of electrical supply

to the fuel cycle area. This led to the Nuclear Installations Inspectorate (NII) and the Scottish Environmental Protection Agency (SEPA) undertaking an audit of safety management arrangements at Dounreay. Their audit report (1), which was published in September 1998, contained 143 recommendations and the UKAEA's response *"The Way Ahead"* (2) was published in November 1998. One of the key recommendations was the need for an integrated decommissioning and waste management strategy for the site, underpinned by a policy that the work should be completed as soon as reasonably practicable.

PLANNING – THE NEED FOR AN INTEGRATED APPROACH

During the early 1990's, UKAEA developed a planning methodology for decommissioning projects involving four levels of detail, in which the forward strategy and plans for decommissioning each facility and the estimates of cost and timescale were progressively refined. This approach provided a reference decommissioning strategy for each facility, and when aggregated provided the basis for developing an overall site decommissioning plan. Data from these studies was then used to provide estimates of waste types and quantities, and this was used to derive a conditioning strategy for each waste stream and identify requirements for new waste treatment plants.

Although this approach gave a reasonable starting point for short-term planning of individual projects, it has since been found to have some significant shortcomings. Thus, a major theme of the NII/SEPA audit was for UKAEA to develop an integrated waste management and decommissioning strategy, as there was a concern that our previous approach to planning had been fragmented. There was also a concern that the timescale for decommissioning the site, which was then estimated to be around 100 years, had not been optimised.

In order to meet this challenge, the UKAEA's response was to set up a team tasked with delivering, by September 2000, a detailed integrated plan for decommissioning, and eventual restoration, of the Dounreay site, on a timescale which is as soon as reasonably practicable. The work to develop this plan has included detailed studies to identify:

- the preferred decommissioning option for the nuclear facilities on the site;
- the production of a detailed waste inventory and a strategy for conditioning each waste stream;
- the requirement for new waste management facilities and other infrastructure needed to support the decommissioning programme;
- the preferred location for these plants;
- the definition of the end point for the site;
- the resources needed to deliver the plan;
- the optimum sequence and timing of the key activities;
- the key risks and areas of uncertainty.

The output is a suite of documents that address different aspects of the overall task of restoring the Dounreay site. Taken together they form an 'integrated site restoration plan' for Dounreay, and they will provide the basis for detailed planning of the site restoration programme through to completion.

THE DOUNREAY SITE RESTORATION PLAN (DSRP)

The DSRP is the first example in the UK of a detailed blue print for the total restoration of a major nuclear site. Restoration encompasses the decommissioning of all facilities (including those which have yet to be built in order to enable restoration to proceed), the management of all waste, both historic and that which will arise from decommissioning, and the remediation of contaminated land. The major components of the Plan are:

Overview (Volume 1)

This is an executive summary of the top level plans and includes a Glossary of specialist terms. The Plan and its complementary Programme will be used to control and monitor the decommissioning and restoration of the Dounreay site.

Restoration (Volume 2)

The Restoration Strategy sets out UKAEA's current vision of the future for the Dounreay Site and provides a strategic overview of the entire restoration process. It seeks to project evolution of the Dounreay Site from the present day to the conclusion of restoration. It presents the target endpoint conditions on completion of decommissioning, at the end of the restoration period and beyond into the distant future. The goal is to carry out site restoration whilst assuring the safety of the public, the workforce and the environment; achieving value for money for the UK taxpayer; generating appropriate records and quality management systems; minimising waste production; and gaining the approval of Dounreay's stakeholders.

The general philosophy is to progressively decontaminate, dismantle and remediate to reduce the number of facilities on the Site, whilst treating and packaging waste so that it is suitable for long-term storage or disposal. Conditioned waste will be stored in modern, purpose built facilities, before the eventual removal of the Intermediate Level and High Level Waste from the Site for disposal. Any residual radioactivity, or authorised disposals on-site, will be left in a state or condition agreed by regulators as being appropriate to ensure long-term safety and protection of the environment. Building superstructures will generally be demolished and removed. The approach for substructures may be different in that as long as it is passively safe, some material with defined residual levels of radioactivity may be left below ground.

Decommissioning (Volume 3)

The Decommissioning Plan describes the decommissioning strategy for the Dounreay Site and the organisation required to undertake the proposed programme of work. It identifies the factors to be taken into account when deciding upon priorities and discusses how constraints on the rate of decommissioning can be managed.

The site and its surrounding areas are divided into 19 zones for the purposes of decommissioning and ground remediation. For each zone the decommissioning plan presents the current state, identifies the proposed end state on completion of decommissioning and restoration, discusses the list of decommissioning tasks required to achieve this state and estimates the levels and types of wastes which will be created as a result of the work. Any necessary development work is also identified.

Radioactive Waste Management (Volume 4)

The Dounreay Radioactive Waste Management Document (DRWD) provides a single comprehensive source of authoritative information on radioactive waste management at Dounreay. It addresses all aspects of the waste management system, including technical details and strategies covering individual waste streams, waste routes and waste facilities. The DRWD has been structured to facilitate keeping the information it contains up-to-date.

More than one hundred waste streams have been identified to date, and this number is likely to increase as streams are broken down into sub-streams requiring different waste treatment. The DRWD includes physical descriptions of the waste, inventory data, waste properties, strategies leading to final disposal (and the threats to these strategies), treatment processes and the status of regulatory approvals needed for each waste stream.

UKAEA policy is for wastes to be immobilised for long-term storage where approvals for the acceptability of the immobilised waste for final disposal have been obtained. Priority for treatment in the waste facilities is given to those waste streams that will give the greatest safety benefit, e.g. immobilisation of liquid wastes will usually give a greater safety benefit than immobilisation of solid wastes with a similar level of radioactivity. The proposed strategy for each individual waste stream has been tailored to take into account the availability of treatment and storage facilities, funding and other relevant factors.

Estate and Utilities (Volume 5)

The Estate and Utilities Plan addresses long-term general site infrastructure issues and indicates the manner in which the various support facilities and site services will be managed to support site restoration. Site utilities/services covered include electricity, water, steam, compressed air, site drainage (non-active) system, nitrogen, argon, site computer and telecommunications networks, roads and car parks, street lighting, fences and alarm systems. The range of support facilities includes office accommodation, workshops, stores, laboratories, security, training and emergency facilities.

Nuclear Fuels Inventory and Management (Volume 6)

This document sets out the plans and programme for the management of all fuel liabilities held at Dounreay. A dedicated system for recording the quantity, location and preferred treatment option for all fuel items in the inventory has been prepared as part of the environmental restoration process. This will be the primary vehicle for reviewing and reporting the availability of preferred methods of fuel treatment to allow environmental restoration of the site to progress. It recognises that some methods of treatment may only be available for a limited period of time, and that others may require development to allow them to become fully operational.

The fuels plan includes information relating to the quantities, nature and possible methods of treatment for different fuel types. The treatment of fuel from PFR was the subject of government consultation in Spring 2000. UKAEA will implement the selected option when the Government decision is made.

Contaminated Ground (Volume 7)

A data capture, assessment and evaluation system has been developed which is linked to a computerised Geographical Information System (GIS) system to record data relating to contaminated ground at the Dounreay site. This enables continual assessment and evaluation of the results from both radiological and non-radiological investigations of contaminated ground and from specific environmental and site projects, from which a list of actions and recommendations can be produced. These are prioritised to form the basis of a contaminated ground management programme. This evaluation process is referred to as the 'sentencing' of contaminated ground. The current assessment process uses a systematic and consistent approach to sentence each area of radiological and non-radiological contaminated ground across the site.

Programme (Volume 8)

This describes how the integrated decommissioning and waste management programme was developed and the important outputs, e.g. human resource needs, waste arisings and costs, which are available from the programming tools used. The overall programme is built up from programmes for the decommissioning of individual 'process' facilities, the development, design and construction of new facilities, the operation of waste processing and storage facilities, the remediation of contaminated ground and maintenance and replacement of site infrastructure. Logic links between the programmes together with known constraints are used to determine the rate and order in which decommissioning and demolition can take place. Integration of individual programmes into the overall restoration plan was achieved by involving a multi-disciplined team throughout the process of reviewing the logic, prioritising tasks and ensuring that resources are allocated to the most important projects.

It had previously been estimated that the timescale to decommission the Dounreay site would be around 100 years. However the work to develop the DSRP and optimise the decommissioning programme has shown that this can be reduced to around 60 years by bringing forward the final stages of decommissioning of the reactors. It is expected that all major radiological hazards will have been removed from the site within the first 25 to 30 years. By then all fuels should have been either processed or conditioned for storage and intermediate and high level wastes packaged in a form suitable for long-term storage and/or ultimate disposal in a national repository.

Two versions of the DSRP have been produced to bound the range of possible options for treating the fuel liabilities. One version addresses the strategy in which both irradiated and unirradiated PFR fuels are reprocessed at Dounreay. The other considers the Minimum Treatment Strategy, in which all PFR fuels undergo treatment at Dounreay to put them in to a form suitable for interim storage and – dependent on future Government policy – eventual direct disposal. The options are consistent with the public consultation paper 'Making the Right Choice' (3). The main difference between these two programmes is that with one, the decommissioning of the Dounreay reprocessing plant, D1206, would commence some 15 years earlier. There is however no significant difference to the site restoration end date.

DELIVERY OF THE PLAN

For the next 60 years UKAEA at Dounreay will be focussed solely on the delivery of the DSRP, and all business processes are being tailored to achieve this goal. As a result, the Management Structure,

Business Plan, Budget, Vision and Goals have been aligned with the major processes of decommissioning, waste management and land remediation. The DSRP will provide information with which to review and modify the existing 1, 4 and 10-year programmes. Put simply, the DSRP is the strategic business plan for the site: - UKAEA will be judged by regulators, government and the public against our progress in delivering this plan.

Clearly decommissioning Dounreay is a major activity and meeting the DSRP timescales will be a challenge. Production of the DSRP has required the integration of some 1,500 separate but inter-dependent project activities such that a change to the timing of one project may affect many other projects and have an impact well beyond what might have been assumed at first sight. Delivery of DSRP is also subject to external risks that are outside the direct control of UKAEA. For example, the Plan assumes that a UK National Repository for intermediate level waste (ILW) will be available in 2040 and that suitably conditioned ILW will be transported to the repository over the subsequent 20 years. If an ILW repository is not available on this timescale, either the site closure date will have to be delayed or interim storage found elsewhere.

Against this background, UKAEA has decided not to peg the delivery of milestones in the Plan to single dates. Instead, programme risks have been identified and assessed, and actual delivery dates within the Plan are expressed as a range, in line with good project management practice. For all activities in the Plan, UKAEA will focus its efforts on delivering to the earliest practicable dates. However, in prioritising the work, it is recognised that there are some activities that are particularly significant in reducing hazards on the Dounreay site, e.g. the immobilisation of liquid wastes and the treatment of the sodium and sodium/potassium alloys used as coolants in the fast reactors. These projects will be given a high priority status and kept under review to see if further ways of shortening the timescale for delivery can be achieved.

UKAEA will make use of the best available planning tools to manage the DSRP. Industry standard planning software is used to allow the DSRP to be tailored to fit the evolving situation and to include the effect of constraints, such as personnel, budget, waste storage needs and processing capacities. Geographical information systems are also utilised heavily to hold disparate sources of data. Within the planning output the dependencies that are key to the effective management of the Programme are represented by logic links. These links have been identified through strategic option studies and reviews by experienced and knowledgeable staff, workshops and independent expert peer review.

Delivery of the Plan to time and cost will depend upon obtaining and deploying the right people, selecting and building appropriate plant and imposing strong project management. A further requirement is the need to have effective processes. To deliver this plan and to meet the obligations of a nuclear site operator UKAEA at Dounreay must, throughout the duration of the Plan, have sufficient staff with the right skills, experience and qualifications. Ensuring a continuous supply of the right staff is therefore one key to success: for a remote site such as Dounreay it is one that cannot be taken for granted.

The present judgement based upon these considerations is that the UKAEA core team at Dounreay should be between 1,000 and 1,100 for the next 15-20 years. However, the argument is not simply about numbers. To this end Dounreay has created a new Engineering Group with responsibility for setting and maintaining engineering standards across the site, and has substantially strengthened the team of safety case writers. Allied to this, UKAEA cannot accomplish the delivery of the restoration

plan without the use of contractors. Contractors will be involved, in association with core UKAEA teams, in all stages of individual projects until the restoration plan is complete.

MAJOR PROJECTS

Within the Plan there are a number of major projects that have been underway for some time and are following well-established programmes, e.g. decommissioning of PFR and DFR. Many of the existing waste management and support plants at Dounreay will also need to remain in service to support ongoing operations. However much of the work in the next 15 years will be directed towards supporting the provision of new facilities that are required to deliver the site's waste management strategy. These include:

- a Vitrification Plant for conditioning liquid high level waste;
- Fuels treatment plants, including some that will depend on the outcome of the ongoing fuel options study (Making the Right Choice consultation).
- a new Low Level Waste (LLW) Facility.
- Intermediate Level Waste (ILW) Projects, including plant and associated stores for the recovery and treatment of historic wastes including those from the shaft and silo.

Project Teams have been formed to make progress with these tasks. Each team is tasked with the development of a user specification, preliminary design specification, design safety principles and an outline safety case and project programme. The selection, design and build of new plants will be subject to BPEO studies to address environmental considerations, and will including consultation with appropriate stakeholders. Thereafter the teams will be restructured to take the projects into the next phase of detailed design and letting of contracts.

STAKEHOLDER CONSULTATION

Much of what Dounreay intends to do in the future will depend upon gaining acceptance of the DSRP from a wide range of stakeholders. A lesson from the past is that the decide - announce - defend approach is no longer acceptable. UKAEA accepts that to deliver the restoration plan to time will require a more proactive approach to meaningful consultation with key stakeholders. World-wide practice and recent UK pronouncements (e.g. the from the Government's Radioactive Waste Management Advisory Committee and the House of Lords) suggest that the best chance of gaining approval to move ahead with major developments in the nuclear and environmental arena is to have open and transparent decision making processes with full involvement of stakeholders. Thus the DSRP has been made available via the Internet (www.ukaea.org.uk). After that stakeholder management will need to be undertaken to ensure groups form for particular interests and information communication channels are set up.

CONCLUSIONS

The UKAEA's mission at Dounreay is to restore the site in a way that is:

- Safe and secure;
- Environmentally responsible;

- Value for money;
- Publicly acceptable.

The mission represents a major task involving the completion of hundreds of individual items of work. As part of UKAEA's planning process a suite of documents has been developed, each of which covers a different aspect of the overall task of decommissioning the site, and when taken together they provide an 'integrated plan'. This plan, the Dounreay Site Restoration Plan, charts the way ahead for Dounreay from its present status to its eventual restoration for the use and benefit of future generations. For the next 60 years we will be focussed on delivery of this plan.

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