

Major Achievements of the Springfields Decommissioning Program-16512

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ABSTRACT

Since the 1940s, Springfields has manufactured fuel products for the UK's nuclear power stations and for international customers. The early operations were in support of the atomic weapons program, closely followed by fuel manufacture for electricity generation via the Magnox power stations commencing in the late 1950's.

In 2005, responsibility for the assets & liabilities of Springfields was transferred to the Nuclear Decommissioning Authority (NDA). A new company, Springfields Fuels Limited, was created to run the site, which was managed and operated by Westinghouse Electric UK Ltd on the NDA's behalf. On April 1, 2010, Westinghouse entered into an agreement with the NDA for a long-term lease of the Springfields site, which transferred responsibility for the commercial fuel manufacturing business and Springfields Fuels Limited to Westinghouse.

Today, the main Springfields activities include:

- Oxide fuels for Advanced Gas-cooled and Light Water Reactors, as well as intermediate fuel products, such as powders, granules and pellets
- Manufacture of Uranium Hexafluoride (now in Care & Maintenance)
- Processing and recovery of Uranium residues
- Decommissioning and demolition of redundant plants and buildings

Some 120 plant buildings and support facilities have been successfully decommissioned and demolished in the period 1996 to date. These range from 1940s buildings, subsequently converted for nuclear fuel manufacture, together with some of the formerly sealed chemical agent manufacture and storage facilities.

Decommissioning of the now redundant Magnox manufacturing facilities is ongoing at Springfields without compromising the other site operations. Westinghouse is managing all activities related to the whole lifecycle, planning, design, safety case, radiation protection, Post Operational Clean Out (POCO), service diversions, characterization, decommissioning all phases through to ground remediation, waste disposal and agreed end states.

Decommissioning of process plants starts with the removal of the majority of radiological activity or hazard contained within the plant. This is known as Post Operational Clean Out. Once this is complete, the plant may be dismantled.

Work is scoped and defined within packages (at plant or cell level) to aid control and commercial monitoring as the decommissioning is progressed.

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This package approach also enables clean or lightly contaminated items to be removed separately to aid potential re-cycling and minimize decontamination and waste disposal costs.

Westinghouse is further optimising work package delivery by planning parallel POCO and Decommissioning work phases within plant at a cell level to systematically remove redundant plant and reduce hazard earlier, whilst optimising use of both internal and external resources to reduce total project cost.

Waste and Residues from all phases are disposed of via authorized disposal routes and in accordance with our environmental authorizations.

On completion of decommissioning and removal of plant and equipment the building is re-assessed radiologically, categorized and appropriate remediation work progressed to render it safe for conventional demolition.

The major elements of the success achieved to date can be attributed to the following elements:

- Overall programme management with extensive experience of planning, cost, and risk management. Integration of the programme within a major commercial site without compromising safety or operations.
- Complete site EHS management working within a complex regulatory framework including the Nuclear Site Licenses, Environmental Authorisations and Security requirements.
- Avoiding safety complacency by use of rigorous and systematic process to emphasise safety over competing goals. Including structured use of Human Performance and Corrective Action and Learning processes.
- Unique safety experiences attained through complex hazard reduction across a broad range of uranium manufacturing and chemical hazard/agent facilities.
- Project leadership and excellence utilizing a core site team to deploy repeatable processes and safe practices to deliver complex scope within budget and schedule.
- Optimised use of internal and external resources, with extensive use of Operating Experience to drive continuous improvement and problem resolution.
- Management of Contractors from initial selection, pre-qualification, tender assessment and Performance using varied contract forms across delivery phases.
- Use of Westinghouse expertise for safety case, waste management, uranium recovery, health physics and design.
- Implementation of a work package to ensure gated discreet manageable packages. Underpinned by package specific method statements, with appropriate hold points to maintain management and control of the works.
- Continuous local safety focus via safety planning, induction, plant specific training, proactive risk assessment, and a defined approach

to decoupling operating plant safety cases enabling focussed and useable documentation.

This paper will provide an overview of the latest decommissioning activities achieved on the Springfields site and will focus on best practices that allowed Westinghouse to maintain the program on time and on budget.

1 Introduction

The Springfields Decommissioning Policy and Strategy has evolved over a number of years, during which time there has been a sustainable programme of decommissioning projects which have been completed or are currently well advanced. Springfields policy is to commence the initial stages of POCO and decommissioning as soon as reasonably practicable after the end of a plant's useful life. The initial stages involve the removal of bulk inventories, decontamination of the plant and the immobilisation of residual activity, so that safety is subsequently maintained with minimum surveillance and maintenance. The subsequent stages involving the dismantling and removal of process plant and equipment, and ultimately the demolition of the buildings is required to be undertaken on a timescale which takes into account, amongst other things, the effective utilisation of existing decontamination & waste disposal facilities, manpower and equipment resources, and the possible re-use of buildings and structures.



Springfields remains an operational fuel production facility, and as such, decommissioning is required to be carried out in a manner that provides for the protection of the health and safety of the workforce, the public and the environment. All decommissioning activities must conform to the Company's health, safety and environmental protection policies and requirements which, as a minimum, are in accordance with currently prevailing external regulatory requirements.

Decommissioning Strategy

The Springfields Decommissioning Programme incorporates the decommissioning requirements of all existing plants, support buildings and facilities on the Springfields Site and includes the restoration of the site at the conclusion of the Nuclear Site Licence.

The start date for the decommissioning of any particular building is based on the latest assumption for the end of its useful life. These dates are kept under continuous review to take account of changes in the business needs. The decommissioning of the original Oxide facilities commenced circa 1999, and this coupled with the end of life of the Magnox stations (together with other miscellaneous redundant facilities) has generated the current peak of decommissioning activity.

Fuel production plants, especially those handling uranium, gain nothing from radioactive decay. In addition, the cost benefit of eliminating surveillance and maintenance activities, after production activities have ceased, leads to early decommissioning being the preferred strategy. Site termination is not expected before 2040, based on current production plant projected lifetimes.

Future strategies will maintain a flexible approach and avoid, where possible, the premature foreclosing of options, making it possible to accommodate changes due to business, technical and regulatory developments, for example.

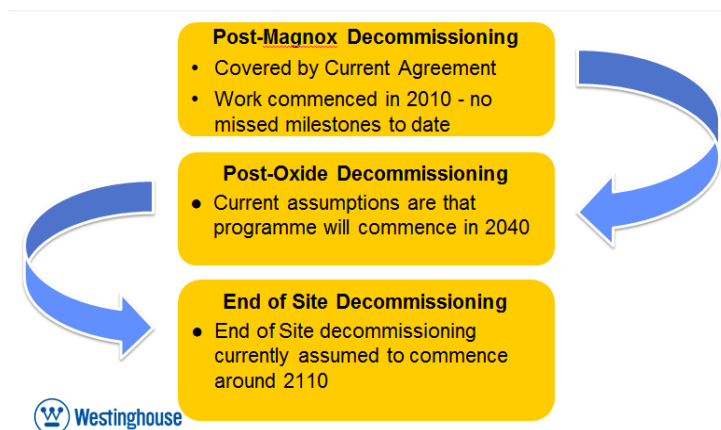
NDA Decommissioning Agreement

In 2005, responsibility for the assets & liabilities of Springfields transferred to a new UK Government body, the Nuclear Decommissioning Authority (NDA). The NDA is a public body whose purpose is to oversee and manage the clean-up and decommissioning of the nuclear sites under its responsibility. A new company, Springfields Fuels Limited, was created to run the site, which was managed and operated by Westinghouse Electric UK Ltd on the NDA's behalf.

On 1st April 2010 Westinghouse subsequently entered into an agreement with the NDA for a long-term lease of the Springfields site, which transferred responsibility for the commercial fuel manufacturing business and Springfields Fuels Limited to Westinghouse, including the freedom to invest for the future under the terms of a new 150 year lease. Springfields Fuels Limited was also contracted under a separate Decommissioning Agreement to provide decommissioning and clean-up services to NDA to address historic liabilities ongoing prior to the sale. This contract operates on a target cost basis offering incentives to Springfields Fuels Ltd to deliver contracted decommissioning projects efficiently by sharing the risk of over/under spend through a pain share / gain share mechanism.

To date, all contracted projects have been successfully delivered on time & within target cost. The importance of a robust scope evaluation and cost

estimating process at the project planning stage through to project execution, coupled with a detailed contractor management strategy during project delivery is of particular relevance.



2 Springfields Decommissioning Cost Estimation Model

The Decommissioning Business Model is a financial planning tool designed for decommissioning liabilities at the Springfields site. The model was initially developed at the start of the latest significant phase of decommissioning in the 1990s as a means of estimating costs for the whole of the Springfields site. It covers all buildings and support facilities and includes for restoration of Site at the conclusion of the Nuclear Site Licence. Cost data is based on historical decommissioning costs, estimates and part engineering handbooks. The model is not intended to estimate accurate 'Class A' costs and quantities for individual buildings or operations, but rather provides a logical and consistent basis for establishing total Site decommissioning costs using relatively simple data criteria such as:

- Volume of the building
- Type of operation carried out in the building
- Level of contamination

Definitions/Project Stages for Estimating

The following terms and definitions are used in the model:

Building Volume

The volume for each building associated with a process, product or service is based on the approximate length, width and 'seen' height of the principal structure and is assumed to include an allowance of up to 5% for ancillary facilities (i.e. external plant, storage rafts etc.) in the immediate area. If the total volume of the ancillary facilities summate to >5% of the principal structure then, assuming a similar contamination category, this volume is also included in the principal structure calculation. If a significant difference in the contamination category is identified, the buildings are included in the model separately.

Initial Design and Engineering

From plant shut-down and prior to commencement of full Stage A decommissioning activities, an initial preparatory phase will involve, amongst other items, management preparation of Stage A decommissioning, design effort, capital expenditure, pre-sanction documentation etc.

Care and Maintenance

For the period from shut-down to commencement of Stage B/C decommissioning the plant and its equipment is assumed to be maintained in a safe and controlled condition. This care and maintenance involves activities such as routine plant visits, fire watches, maintenance of the building fabric, upkeep of the drains and foul water systems, operations and maintenance of the plant extract and if necessary plant heating systems.

Stage A Decommissioning

Removal and disposal of the main items of plant and equipment plus suitable decontamination such that the building could be reused for a similar purpose, or prepared for post demolition disposal via the relevant waste stream. The waste arising from such activities, described as *Equipment Volume*, is estimated by taking into consideration an 'equipment density' factor specific to the building utilisation.

Stage B/C Decommissioning

Demolition and disposal of buildings, foundations, associated raft areas, underground services, removal of any contaminated ground and restoration of the site. Depending on each building's requirements, Stage B/C can be split to give Stages B and C if it is considered that this stage will not be completed during a continuous decommissioning phase. Further post Stage A decontamination and characterisation monitoring may also be carried out during this phase as necessary with the aim of minimising the ultimate demolition and disposal cost.

End of Site Decommissioning

Decommissioning of the remaining site at the end of operations including suitable decontamination and remediation of the remaining site area footprint. The assessment is based on the removal of all tank farms, rafts and services above ground, flushing out of drains, disconnection/removal of the electrical distribution infrastructure and removal of roadways/railway track.

Decontamination

Decontamination as necessary with the aim of minimising the ultimate disposal cost. The activities include monitoring and segregation of all arisings to identify those items which without decontamination would require disposal to LLWR. Decontamination of these items would then take place, if it is considered cost effective, to enable them to meet either free-release criteria or the landfill disposal authorisation.

Basis of Costs

Unit rates for management, design, engineering, decontamination and disposal are based on actual data where available. In the absence of actual data estimates are prepared based on historic data, engineering handbook information, independent consultancy data and supporting independent estimates. Standard norms used within the estimating worksheets have been derived from previous tender returns, contracts, current contractors, external and specialist firms.

The estimating basis of costs is reviewed at least annually and verified against current market rates, previous projects, disposal rates, Landfill Tax and Management tariff. Prior to submission of decommissioning work proposals for financial sanction, a formal risk assessment and analysis will be carried out on all significant projects generally aimed at producing an 80-90% probable outcome of the overall project cost and project end date.

3 Health, Safety and Environmental

Decommissioning Safety Cases are prepared before the commencement of each decommissioning project in accordance with the requirements of the Springfields Environment, Health & Safety Committee and the Nuclear Site Licence. For all projects the following are separately addressed within the document:

- Hazard identification
- Risk assessment
- Safety category assessment
- Dose uptake
- Environmental impact
- Management of safety

Safety Documentation

Site Licence Condition 14 requires arrangements to be in place for the production and assessment of safety cases consisting of documentation to justify safety during the design, construction, manufacture, commissioning, operation and decommissioning phases of the installation.

The complexity of a safety case will depend upon the nature and form of the hazards which are being assessed. All reasonably foreseeable hazards are addressed and assessments should show that the relevant criteria and standards have been satisfied. The overall objective is to demonstrate that the risk presented by the plant or operation to the public, the workforce and the environment is ALARP.

The safety case defines the safe operating envelope for the plant or operation, and any conditions or limits that are required to define the envelope are clearly identified as Operating Rules (ORLs). Similarly any Operating Requirements (ORQs) and Safety Mechanisms (SMs) required

to ensure that ORLs can be satisfied are identified. These and any Operating Assumptions (OAs), Safety Related Items (SRIs) and Safety Features (SFs) required must be clearly listed on the Decommissioning Operational Clearance Certificate (DOCC). Specific requirements for examination, inspection, maintenance and testing are clearly defined and put in to the plant maintenance schedule.

Plant Modification Proposal Process

Prior to embarking on the preparation of a safety case a proposal is formally categorised using the Plant Modification Proposal (PMP) process. The assigned category will determine the safety documentation requirements for the proposal.

The categories used are:

Safety

A plant/operation/activity that has the **potential** to lead to:-

A major impact on a member of the public is	Category A
A significant but less than major impact on a member of the public or a major impact on a member of the workforce is	Category B
No more than a minor impact is	Category C
Only a trivial or no impact is	Category D

Environmental

A plant/operation/activity that has the **potential** to lead to:-

A major effect on the environment on- or off-Site is	Category E1
A minor effect on the environment on- or off-Site is	Category E2
A trivial or no effect on the environment is	Category E3

Safety is defined as nuclear, radiological, chemotoxic, environmental and conventional safety (including fire safety), with Category A and B modifications made subject to Independent Nuclear Safety Assessment. All other proposals are internally peer reviewed by the relevant Management Safety Committee prior to work commencing.

4 Commercial Framework, Competitive Tendering and Contractor Management

Under the terms of the Decommissioning Agreement with NDA, Springfields is required to offer all work packages for competitive tendering wherever it is considered practical and safe to do so, and from the Customer viewpoint recognises the desire to maximise the competitive tendering principle.

The overall project management, safety case ownership and supervision of contractors is carried out in-house by the Springfields Projects and Decommissioning Group.

Fixed price or schedule of rates contracts are generally sought wherever the work packages can be sufficiently defined. Target price or labour only contracts may be more appropriate for some activities requiring close supervision or in cases where it is not possible to adequately define the work packages in advance. The limited use of in-house Term Contractors is also utilised for small work packages where the cost of the tendering process is not cost effective.

Project Contractor Safety Planning

Project work undertaken by Contractors is generally arranged through a Contract Manager. Contractors identified to undertake Project work must complete a suitable EH&S plan prior to commencing work on site, the objective being to address the risks arising from the works, the controls which will be applied to minimise these and the contractor's arrangements for active monitoring to ensure that the controls are effective. In addition it will ensure that an assessment of potential risks and exchange of relevant information takes place in order that appropriate solutions are agreed and recorded.

The Contract Manager on behalf of SFL will identify:

- What local rules or procedures are relevant and what restrictions, if any, apply.
- Any specific site hazards and size of risk that could affect the contractor and their employees.
- Environmental issues relevant to the contract.
- What Safe Systems of Work will apply and whose will be used.
- Methods of work the contractor shall follow in circumstances where, exceptionally, SFL retains control of specific activities.
- Any concerns regarding materials, equipment or services the contractor wishes to use.

Any contractor working on a specific Project must have a completed Contractor Management plan prior to commencing work on site which will clearly define the scope of the contractors work activities, responsibilities for the work to be undertaken and details of all the associated EH&S management systems and standards the contractor will need to adhere too. Where a clearly defined area can be handed over then the authority for this is given by completing and issuing a 'Limitation of Access' certificate. Buildings, plant, equipment and services within the segregated area remain SFLs property, and SFL remains responsible for warning the contractor of any particular hazards associated with them that they could not reasonably be expected to know. SFL also remains responsible for the activities of its own employees, and retains some responsibility for the activities of any other contractors it may have employed to work in the same area.

5 Contractor Management – Health & Safety Principles

All contractors to be utilised during decommissioning works will have been pre-qualified for work on the Springfields Site. Sub-Contractors working for the above have to be approved by SFL before working at Springfields, plus a Safety Management System appropriate for the size and nature of the work of the sub-contractor is always required.

Management of Activities with Risks to Health & Safety

The common hazards / risks associated with working on the Springfields site are managed by adherence to and compliance with:

- Site Induction Training (Toxic Release, Fire, Criticality procedures etc.)
- Limitation of Access
- Ionising Radiation Regulations
- Site instructions for Contractors, HSE Requirements
- Induction training specific to the building or area in which the work is being carried out (local alarms and emergency arrangements)

Further information and training is given to all personnel employed on the project via a number of additional delivery mechanisms including:

- Contractors' weekly toolbox talks
- Pre-job Briefs
- Project specific training and information
- Nationally recognised construction training schemes.

Monitoring Workplace Activities

The SFL contractor interface ensures that periodic monitoring and inspection of a contractor's performance is undertaken. Duration and frequency is assigned commensurate with the level of risk of the activities being performed; this is identified during initial H&S planning.

Management Review of Performance

SFL and contractor management meet regularly to review the contractor's performance and other relevant factors associated with the works. Environmental, Health and Safety is always be on the agenda of such meetings. On an annual basis or at the end of the contract if earlier, the contractors EH&S and Service delivery performance is assessed and recorded.

Radiation Protection for Contractors

Contractors working on the site in radiologically designated areas are required to appoint a Radiation Protection Adviser (RPA) which is normally a SFL site RPA. All contractors working within designated radiological areas need to be aware and strictly follow of the requirements of the Local Rules for each area they are working in. Where appropriate, radiological

risk assessments for work carried out in controlled areas are generated by local SFL RPAs in line with contractor's method statements.

6 Summary

Over the last twenty years a significant phase of decommissioning at Springfields has been successfully completed. Over 120 buildings and facilities have been safely decommissioned and demolished as the site looks forward to the future and is actively transformed from its Magnox manufacturing days.



**Site Aerial Photograph
circa. 1994**



**Springfields post-2020
on completion of Magnox
Decommissioning**

A recognised key factor in the success of the Springfields Decommissioning programme to date has been strategic early decommissioning immediately following the end of a plant's operational life. This allows the utilisation of existing site knowledge and experience both from past decommissioning projects, plus operational knowledge and LFE from former plant operators, management and support functions. Early decommissioning also means existing waste disposal routes/authorisations can be fully utilised and any future care and maintenance costs are minimised.

During decommissioning, knowledge and experience from previous projects is also utilised by the Project Manager and all members of the in-house Decommissioning Team supported by the RPA to keep the dose uptake of individuals and the workforce as low as reasonably practical (ALARP). This is achieved by various methods including training and briefing of LFE, use of established good working practices, planning of the work based on previous experience and ongoing monitoring of air and surface contamination levels.

Other notable highlights can be summarised as follows:

- Use of the decommissioning cost estimation model has been proven to provide Springfields with a predictable cost estimation tool. Project out-turn cost over the life of the current NDA Decommissioning Agreement has averaged ~90% of model cost,

with no single project exceeding the sanction value. The estimating basis of costs can be regularly reviewed against current market rates, previous projects LFE etc.

- Existing site knowledge and experience both from past decommissioning projects (plus in-house operational knowledge) is fully utilised when developing decommissioning project scopes. This, coupled with the predictable cost estimation tool, allows accurate decommissioning project schedules and cost profiles to be developed. Under the current NDA Decommissioning Agreement, 100% of the contracted project milestones have been achieved.
- The contracting strategy at Springfields encourages partnering and collaboration as a way of achieving shared targets and project success. Depending on the type of work, contracts are structured to provide contractors with incentives to succeed, normally through gain-share/pain-share mechanisms.