Waste Informed Decommissioning

Model and principles

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<tr>
<td>ALARP</td>
<td>As Low As Reasonably Practicable</td>
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<tr>
<td>BAT</td>
<td>Best Available Technique</td>
</tr>
<tr>
<td>BPEO</td>
<td>Best Practicable Environmental Option</td>
</tr>
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<td>BPM</td>
<td>Best Practicable Means</td>
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<tr>
<td>CCFE</td>
<td>Culham Centre for Fusion Energy</td>
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<td>DQO</td>
<td>Data Quality Objectives</td>
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<td>FED</td>
<td>Fuel Element Debris</td>
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<td>HAW</td>
<td>Higher Activity Waste</td>
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<td>ILW</td>
<td>Intermediate Level Waste</td>
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<td>Project Waste Management Plan</td>
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<td>SGHWR</td>
<td>Steam Generating Heavy Water Reactor</td>
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<td>SQEP</td>
<td>Suitably Qualified and Experienced Person</td>
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<td>VLLW</td>
<td>Very Low Level Waste</td>
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1. What is the purpose of this model?

This waste informed decommissioning paper aims to provide a model and the principles governing how waste informed decommissioning can be planned and executed in the nuclear industry. Waste informed decommissioning is a method of delivering decommissioning to ensure that the optimum decommissioning and waste management outcomes are achieved (so that one is not performed well in isolation at the expense of the other). In doing so, the delivery of waste informed decommissioning could bring a range of potential benefits in terms of time, cost, effectiveness and reputation for both the decommissioning and waste management aspects of a project.

It is intended that this model can be used by project managers, project engineers and all those involved in the planning and execution of decommissioning projects as a tool to inform decision making and to support the implementation of waste informed decommissioning approaches. This is not a “how-to” guide but rather a description of the “why” and “what” of waste informed decommissioning to support the development and implementation of approaches on real projects and programmes. The model describes an ideal state, including aspects which are either in development or else are opportunities for the nuclear industry. It is recognised that in reality, different aspects may be implemented by projects and programmes at different times depending on their individual drivers and constraints.

2. Structure of the model

This model describes the components required to deliver successful and effective waste informed decommissioning in the nuclear industry including:

- The definition.
- The approach.
- The benefits of the approach.
- The principles of the approach.
- What it would look like in practice for an ideal situation.

3. Scope

This model applies across the whole decommissioning lifecycle (from cessation of operations through post-operational clean out (POCO) to deplanting, deconstruction and final demolition). It is a model which is fundamentally about decommissioning and how relevant elements of the decommissioning process can be adapted to ensure that projects deliver the most successful decommissioning and waste management outcomes that can be achieved. Within this context, the model is principally about the process for decommissioning rather than the end points for either decommissioning or waste management; as these are determined at a local level by individual projects, programmes and organisations.

The principles and model are applicable to all classifications of waste from non-radioactive to higher activity waste (HAW).
4. What is waste informed decommissioning?

Decommissioning — the process of decontaminating (where necessary) and dismantling a facility or site at the end of its operational life — is a fundamental process in the lifecycle of nuclear facilities. There is an intimate relationship between decommissioning and waste management, since waste is the principal product of the decommissioning process. In addition, effective waste management is required to enable a site to reach its interim or final end states.

Historically, there has been a disconnection between decommissioning and waste management. These were undertaken (in the worst case) as separate activities, often by separate teams of people, with limited consideration as to how one process affected the other. This typically meant that whilst the decommissioning activity was delivered successfully to time / quality / cost requirements, the outcome for waste management may have been sub-optimal (for example by limiting the available waste management routes).

Waste informed decommissioning is a different model for delivering decommissioning.

**Waste informed decommissioning** is a way of planning and delivering decommissioning that ensures that the best possible joint outcomes for decommissioning and waste management are achieved. It involves making waste management an integral part of the decision making, planning and execution processes for decommissioning.

In the waste informed model, there is recognition that the product of the decommissioning process is the generation of waste (whether non-radiological or radiologically contaminated). The waste informed approach brings the decommissioning and waste management communities together to make decisions about how decommissioning is undertaken (from operational transition to POCO and then decontamination (where required) and deconstruction). This means that waste management can be considered alongside other factors such as dose control (ALARP), physical constraints, funding and time constraints in the planning process; to ensure that the end result of the decommissioning process is successful project delivery and the optimal waste management that can be achieved in the situation.

**Example: the potential implications of not delivering waste informed decommissioning**

The project is to decommission and remove a facility on a nuclear licensed site. One room within the building has contamination to Low Level Waste (LLW) levels whilst the remainder of the building is very lightly contaminated.

*Without waste informed decommissioning*

Waste management is not considered during the delivery of the project and so the building is to be demolished in an un-sequenced way. The demolition will result in a large volume of mixed waste classified as LLW, as the specific LLW room was not separated out during the demolition. The result is a large volume of radioactively contaminated waste requiring disposal, and a larger cost for the site.

*With waste informed decommissioning*

Application of the waste informed decommissioning approach on the project will mean that the building is characterised at an early point in the project lifecycle. This will identify that most of the facility can be classified as out-of-scope and only one room was radiologically contaminated. Deconstruction of the facility is to be undertaken in a sequenced fashion, with the waste from the contaminated areas segregated from the out-of-scope waste. The result is only a small volume of waste needing to be managed as LLW radioactive waste, saving significant money and time for the site.
5. The benefits of waste informed decommissioning

Successful delivery of waste informed decommissioning will deliver benefits to both the decommissioning and waste management communities as described in Figure 1.

Figure 1—The benefits of waste informed decommissioning
Benefits realisation, the process of defining and measuring progress against the achievement of benefits, is a key element in project and programme management. It is a tool which enables project managers and decision makers to determine how successful their delivery approach is and allows for periodic adjustment of plans to ensure that the desired outcomes are achieved. Table 1 provides a summary of some example metrics which can be used by the project management community to measure the success of deployment of waste informed decommissioning approaches.

### Table 1 — Measures for achievement of benefits associated with waste informed decommissioning approach

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Measures (Key Performance Indicators (KPIs))</th>
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<tbody>
<tr>
<td>Increased stakeholder buy-in and support to decommissioning plans.</td>
<td>• Number of instances of stakeholder support (or complaint).</td>
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<td></td>
<td>• Attendance at stakeholder engagement sessions.</td>
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<td>Increased supply chain effectiveness and sustainability.</td>
<td>• Spend with small and medium sized enterprises (SME).</td>
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<tr>
<td></td>
<td>• Spend with the supply chain.</td>
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<tr>
<td></td>
<td>• Number / range of suppliers available to project.</td>
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<tr>
<td></td>
<td>• Number / magnitude of safety or environmental issues related to supplier performance.</td>
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<tr>
<td>Increased cost effectiveness for decommissioning and waste management.</td>
<td>• Cost of decommissioning relative to potential cost for non waste informed approach.</td>
</tr>
<tr>
<td></td>
<td>• Cost of waste management relative to potential cost for non waste informed approach.</td>
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<tr>
<td>Increased flexibility in waste management outcomes.</td>
<td>• Volume of waste managed via each waste route (relative to non waste informed approach).</td>
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<tr>
<td></td>
<td>• Volume of legacy and problematic waste managed.</td>
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<td></td>
<td>• Residence time for waste on decommissioning project.</td>
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<td></td>
<td>• Delay (schedule variance) to decontamination / deplanting / deconstruction due to waste residence on project.</td>
</tr>
<tr>
<td>Increased potential for reclassification of waste down the radiological spectrum (HAW → LLW → VLLW → out-of-scope).</td>
<td>• Volume of waste reclassified to a lower radiological classification relative to a non-waste informed decommissioning approach.</td>
</tr>
<tr>
<td>Reduced rework and duplication of effort.</td>
<td>• Amount of rework (or number of “right first time” occurrences).</td>
</tr>
<tr>
<td>Accelerated schedule for decommissioning as it is not held up by pace of waste management activities.</td>
<td>• Variance in schedule relative to non waste informed approach.</td>
</tr>
<tr>
<td></td>
<td>• Duration for waste management activities.</td>
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</table>
6. The principles of waste informed decommissioning

Delivery of waste informed decommissioning involves the consideration of waste management aspects across the decommissioning project delivery lifecycle. Early consideration of the needs, requirements and constraints of waste management enable all those involved in decommissioning delivery to make decisions that allow the best joint decommissioning and waste management outcomes.

These can be summarised by a number of principles for the successful delivery of waste informed decommissioning, as shown in Figure 2.

Figure 2—The principles of waste informed decommissioning

- **Waste informed decommissioning is delivered by understanding the product of decommissioning (waste) and planning for decommissioning with this in mind.**
- **Waste informed decommissioning is achieved by project teams, the supply chain and internal / external stakeholders working together to deliver common objectives.**
- **Waste informed decommissioning is supported by the identification and sharing of good practice, lessons learned and improvements across the nuclear industry.**
- **Waste informed decommissioning is delivered through integrating decommissioning and waste management processes to deliver the optimal mutual outcomes.**
7. What does waste informed decommissioning look like in practice?

Waste informed decommissioning, as previously defined, is a way of planning and doing decommissioning which ensures that the best possible joint outcomes for decommissioning and waste management are achieved for a given project.

It can be achieved through systematic planning and execution of characterisation, decommissioning and waste management activities across the project lifecycle; using information gathered from a previous step to inform subsequent steps. Iterative characterisation (delivered in a purposeful way at relevant times during the project lifecycle) provides useful information on the characteristics of facilities and wastes to inform planning / execution of decommissioning and waste management activities. Characterisation may involve use of history / provenance to make reasoned judgements, intrusive sampling and analysis, measurement (such as Health Physics monitoring or more specialist non-destructive assay) or modelling based on past information and history / provenance. Planning decommissioning and waste management at similar times in the process enables both processes to be delivered in a way that does not impede or delay the other. Frequent gathering and reflecting on learning from each phase of the project allows for real-time adjustment of plans and improvement of delivery process. Stakeholder engagement throughout the process enables stakeholders to be kept informed of the objectives, progress and outcomes of the project; reducing barriers to successful delivery.

A high-level schematic of an idealised waste informed decommissioning project is provided in Figure 3 to illustrate what it could look like in practice. It is acknowledged that depending on the nature of the decommissioning project, not all the project phases are required. The idealised waste informed process is characterised by repeated, iterative cycles of characterisation, planning (for both decommissioning and waste management) and execution.

Table 2 provides additional information on the key considerations relating to waste informed decommissioning which are relevant to the different project lifecycle phases.
Figure 3 — Idealised high-level schematic for waste informed decommissioning
### Table 2 — Key project lifecycle considerations for waste informed decommissioning

<table>
<thead>
<tr>
<th>Process phase</th>
<th>Key considerations</th>
</tr>
</thead>
</table>
| **Project definition** | • Confirm interim and end-states for facility and other project constraints (e.g. start and end dates). Describe end state in terms of waste management approach.  
• Develop Project Waste Management Plan (PWMP) to identify waste management requirements for the project across its lifecycle and high level forecasts of waste quantities. Refine plan and forecasts at planning stages throughout project. Approval of plans by waste management and decommissioning personnel.  
• Define scope, funding, sanctioning etc.  
• Identify resourcing needs and supply chain requirements. Establish commercial arrangements for project and supply chain. Identify integrated teams for the different phases of project delivery. Train personnel as required in time for relevant project phases.  
• Assess what is happening in other nearby projects / programmes / plants and establish upstream / down-stream issues. Establish handshake / interface points with affected plants. Establish potential constraints and areas of conflict with other projects.  
• Undertake risk and benefits management. |
| **Characterisation planning** | • Gather provenance of waste and building history (uses, previous spills / events etc.).  
• Gather relevant information (such as drawings, records etc.).  
• Develop plan and approach for characterisation.  
• Carefully define purpose for characterisation at each phase.  
• Apply best practices to characterisation planning (such as application of the characterisation execution approach). |
| **Characterisation execution** | • Characterise for radiological, chemical (including asbestos for building fabric) and physical properties as required. |
| **POCO planning** | • Confirm end-state for phase and other constraints (e.g. schedule, upstream, / downstream plant issues etc.).  
• Identify interactions with waste management for POCO and feed into planning.  
• Gather relevant information on plant history. |
| **POCO execution** | • Undertake POCO in line with plans, organisational standards, expectations and procedures.  
• Feed information on output of POCO into subsequent process steps (notably waste management for POCO wastes and next characterisation phases). |
| **Waste management planning** | • Refine and maintain PWMP.  
• Identify potential waste routes for all wastes (including interim storage options for problematic wastes and HAW).  
• Feed in results of waste and building characterisation; and any earlier decommissioning planning / execution phases.  
• Determine BAT / BPM for wastes. |
<table>
<thead>
<tr>
<th>Process phase</th>
<th>Key considerations</th>
</tr>
</thead>
</table>
| Waste management execution                                                  | • Undertake waste management in line with plans, organisational standards, expectations and procedures.  
• Feed information on output of waste management into subsequent process steps.                                                                                                                                                                                                                       |
| Decommissioning planning (decontamination, deplanting and deconstruction)   | • Gather relevant information (e.g. engineering substantiation)  
• Assess feasibility and value of up-front decontamination for subsequent decommissioning / waste management steps  
• Assess availability of necessary skilled personnel  
• Determine BAT / BPM for building and contents  
• Determine phasing and sequencing of project activities to enable effective decommissioning and waste management.  
• Develop plan for decontamination / deplanting and deconstruction |
| Decommissioning execution (decontamination, deplanting and deconstruction)   | • Undertake decommissioning in line with plans, BAT / BPM, organisational standards, expectations and procedures.  
• Feed information on output of waste management into subsequent process steps.                                                                                                                                                                                                                           |
| Assurance / LFE                                                              | • Undertake LFE gathering and knowledge management activities at all relevant points through project.  
• Share LFE gathered during project phases.  
• Undertake assurance during planning and execution phases.  
• Consider forecast versus actuals for waste management and route usage. Feedback into future planning phases.                                                                                                                                                                                      |
| Stakeholder management                                                       | • Develop consistent messages regarding the project scope and progress. Share with relevant stakeholders at appropriate points throughout project delivery.                                                                                                                                                                                                 |
8. How can waste informed decommissioning be achieved?

Waste informed decommissioning can be achieved through the delivery of the four key principles described in Figure 2. As summarised in Section 6, it can be achieved in an idealised state by considering both waste management and decommissioning throughout the decommissioning process; and by ensuring that information from the iterative characterisation → planning → execution phases is fed though to subsequent stages to inform that decisions on decommissioning and waste management are robustly underpinned. This section aims to provide more detail on how waste informed decommissioning can be achieved on projects by describing what is involved in delivering the approach in different areas (‘elements’) of the project delivery process. This detailed information (in sections 8.3 to 8.13) describes specific things that can be delivered to enable the waste informed approach to be delivered. Not all of these specific elements may be practicable or achievable (depending on the constraints on individual projects) but any combination of these detailed elements will support a project being more “waste informed”.

8.1 The elements of the project delivery process

Decommissioning projects involve organisation and effort in a diverse range of different areas. For clarity, the detailed descriptions of the waste informed approach in sections 8.3 to 8.13 are divided by the different project delivery “elements” described in Figure 4.
8.2 The principles of waste informed decommissioning in the project delivery process

The four principles for the delivery of successful waste informed decommissioning are summarised in Figure 2 in Section 6. Different combinations of the elements of the project delivery process are relevant to different principles and at different phases of the generic project lifecycle. Table 3 describes how the principles map to the project delivery elements and project phases; providing a tool showing how the different elements can be achieved by different actions in the project delivery lifecycle.

<table>
<thead>
<tr>
<th>Waste informed decommissioning principle</th>
<th>Lifecycle phase where principle is delivered</th>
<th>Aspect(s) where principle is delivered</th>
</tr>
</thead>
</table>
| Waste informed decommissioning is delivered by understanding the product of decommissioning (waste) and planning for decommissioning with this in mind. | Pre-delivery | • Characterisation  
• Planning |
| Waste informed decommissioning is delivered through integrating decommissioning and waste management processes to deliver the most optimum mutual outcomes. | Delivery | • Execution |
| Waste informed decommissioning is achieved by project teams, the supply chain and internal / external stakeholders working together for common objectives. | Delivery | • Supply chain  
• Internal incentivisation |
| • Enablers | • People and organisation  
• Stakeholder management  
• Policies, strategies and regulation |
| Waste informed decommissioning is supported by the identification and sharing of good practice, lessons learned and improvements across the nuclear industry. | Delivery | • Audit and assurance |
| • Post-delivery | • Learning from experience |
| • Enablers | • Knowledge management |

Detailed descriptions of what waste informed decommissioning would look like in practice are provided in pages 16 to 28.
8.3 Pre-delivery: Characterisation

Characterisation—the process of gathering information on the characteristics of a material, item or waste—is critical to the success of waste informed decommissioning. Iterative, timely and purposeful characterisation provides information to underpin decision making on decommissioning and waste management, enabling the best mutual outcomes. Doing characterisation the right way at the right time can save money, time and effort over the project lifecycle.

Scheduling

- Characterisation requirements are identified at the earliest practicable stage of a project.
- Characterisation is planned as an iterative activity over the lifecycle of a project to provide flexibility in approach and outcomes; and is commenced as early as practicable in a project lifecycle.
- Characterisation is phased to deliver appropriate and necessary information to relevant decision making points across the project lifecycle.

Planning and delivery

- Characterisation is recognised as an essential step for effective waste informed decommissioning.
- Characterisation is included as an integral part of the project planning process for decommissioning projects.
- Planning for characterisation is undertaken to ensure that it provides relevant useful information for decision making during the process. It underpins both decommissioning and waste management.
- Characterisation planning involves specialists in characterisation, decommissioning and waste management.
- The purpose for characterisation is clearly defined and articulates what the activity is trying to achieve for decommissioning and waste management.
- Characterisation is delivered in a technically robust manner commensurate with the complexity and constraints of the project. The approach chosen is the right one for the project.

Ownership and understanding

- The accountability for planning characterisation is the responsibility of the project manager. Project managers have access to the right specialist resources (such as waste management, characterisation, Radioactive Waste Advisors and RPA resources) to deliver this.
- All project personnel have an appropriate level of understanding of the characterisation plan for the project.

Inventory management

- Characterisation for decommissioning projects delivers robust, accurate and appropriately detailed inventory information. This is fed into site and national inventory data sets, and is kept up-to-date.
- Inventory data is available to project personnel to support decision making for decommissioning projects.
8.4 Pre-delivery: Planning

Planning is the stage in the project lifecycle where decisions are made on the methodology and approach for the delivery of decommissioning. Considering waste management during planning for decommissioning in the waste informed approach means options are selected that will deliver the best possible outcomes for decommissioning and waste management.

Planning at a project level

- Waste management plans (such as PWMP) for the entire project lifecycle are developed in conjunction with project decommissioning plans prior to work commencing. These are live documents which are maintained throughout the life of the project.
- Project managers are accountable for producing plans for waste informed decommissioning and disseminating them to relevant internal / external stakeholders.
- Production of project decommissioning and waste management plans involves the right stakeholders; and are reviewed by relevant specialists.
- Decommissioning and waste management plans are signed (approved) by SQEP decommissioning and waste management personnel.
- All potential and available waste routes and approaches should be considered during planning for decommissioning. BAT / BPM is fed into the decision making process and business case development.
- There is a standardised approach to planning and delivery of waste informed decommissioning. The standardised approach is applied across the nuclear industry and is proportionate to the size / complexity of the project.
- Plans for waste informed decommissioning are kept live; and are adjusted to respond to change and learning.
- Plans align with corporate strategy, plans, business cases, site licence conditions and BAT / BPM.
- Project plans include high quality, reliable forecasts of waste arisings appropriate to the lifecycle phase of the project.
- Project forecasts are combined to form facility / site forecasts with appropriate descriptions of uncertainty.

Choosing a delivery approach

- Selection of the right waste route(s) for a decommissioning project is integrated into decision making for the decommissioning methodology.
- Decommissioning work management methodologies and approaches are selected, as far as practicable, to ensure optimised outcomes.
- The end point for the decommissioning project includes the successful completion of waste management activities.
- There is early engagement with waste management service suppliers to ensure waste management requirements are known and integrated into decision making on the decommissioning approach.
- Optioneering for decommissioning actively involves waste management specialists.
Application of the Waste Hierarchy is an important factor in decision making about decommissioning approaches.

BAT / BPM is a key consideration in decision making and a requirement of environmental permits.

Decision making makes due consideration of site licence compliance.

**Project scheduling**

- Schedules are designed from a basis of a clearly understood start and end point (where the end point encompasses the waste management phases associated with the decommissioning project).
- Schedules are realistic, with clearly defined milestones (relating to both the decommissioning and waste management activities) and are shared with relevant internal / external stakeholders.
- The project schedule reflects the waste informed decommissioning plan and the expected routes.
- Schedules are developed with input from all relevant stakeholders (including decommissioning and waste management specialists).

**Benefit and risk management**

- Planning for waste informed decommissioning involves effective risk identification and management at a corporate and project level.
- Threats and opportunities reflect all phases of the project across its lifecycle (incorporating decommissioning and waste management).
- Threats, opportunities and benefit realisation are effectively managed across the lifecycle of the project.
- Project / programme / corporate level benefits and risks are clearly articulated.

**Planning at a site or organisational level**

- The business has a defined corporate integrated decommissioning and waste management strategy.
- The decommissioning strategy and supporting plan clearly articulates how decommissioning is optimised and integrated with waste management. There is a clear corporate level “roadmap” for delivery of the decommissioning strategy and plan. This defines decision points, technology insertion points and necessary R&D activities for decommissioning and waste management.
- Delivery is routinely monitored (e.g. through the use of Key Performance Indicators) to ensure successful decommissioning and waste management outcomes.
- Waste management is a specific consideration in the project sanction and gated process for decommissioning projects.
- BAT / BPM and site licence compliance are essential considerations during development of the decommissioning strategy and supporting plan (at all levels).
## 8.5 Delivery: Project execution

Project execution — the stage where waste informed decommissioning is physically performed — is where the waste informed approach will achieve the best possible outcomes for decommissioning and waste management. Organising workfaces, providing the right tools / equipment and ensuring that the right waste management routes / packaging / transport are available are key to ensuring that waste informed decommissioning is successfully delivered.

### At the workface

- Waste is segregated as close to source as practicable
- Work faces are designed and organised to enable effective waste management.
- Waste management tools such as visual aids, relevant equipment and packaging are available on decommissioning workfaces.
- Personnel at the workface are multi-skilled and suitably qualified experienced personnel (SQEP) — able to deliver decommissioning and waste management tasks, and are responsible for both.
- Workfaces are organised (e.g. with adequate space and lay-down areas) for decommissioning and waste management activities.
- An appropriate range of waste packages are available at the workface to support segregation and waste containment.
- An appropriately range of transport routes (rail, road and sea) are available for the transport of waste produced from decommissioning projects.
- Care is taken to ensure safety and compliance where multiple projects are working in close proximity.

### Waste routing

- Waste is managed such that the right waste is routed to the right treatment / disposal facility.
- Appropriate, value for money, fit-for-purpose, easy to use and flexible waste management routes are available for all wastes as appropriate.
- Any necessary approvals (Letters of Compliance, Waste Enquiries, WAC variation approvals, permits, authorisations, licenses, planning consents, Trans-Frontier Shipment Authorisations and Article 37 approvals) are in place prior to the commencement of work (i.e. the generation of a particular waste from decommissioning).
- Appropriate cost-effective waste routes are available for wastes across the radiological spectrum including non-radiological wastes.
- Routes are suitably flexible (e.g. where appropriate wastes can be managed in a raw rather than conditioned state) and are suitably permissioned / available before decommissioning activities commence.
- Buffer and interim storage capability is available on or off site. Decay storage capability is available and in routine use.
- All personnel across a project (project management, operators, contractors) are aware of the full range of relevant waste routes for the decommissioning project.
8.6 Delivery: Audit and Assurance

Audit and assurance are tools which ensure that project delivery happens in compliance with approvals, permits and licenses. In addition, audit and assurance can be used to support the sharing of good practice and lessons learned between projects and organisations.

Governance

- Corporate governance ensures that assurance of waste management practice is integral to project and decommissioning processes.
- There is corporate level oversight of plans for waste informed decommissioning and their implementation.
- There is a corporate-sponsored escalation route; to enable appropriate levels of challenge if waste informed decommissioning is not demonstrated at the planning and / or execution phases of projects or programmes.
- Corporate governance ensures that plans and project / programme delivery takes cognisance of and mitigates key risks from a decommissioning and waste management perspective.

Benchmarking

- Benchmarking against other projects or programmes across the “industrial remediation” industry (nuclear and non-nuclear) is undertaken to enable the identification and implementation of good practice.

Internal assurance

- Decommissioning and waste management is undertaken safely and compliantly.
- Plans and strategies are reviewed (and adjusted to respond to learning, good practice from other projects and external changes) in good time.
- Controls are in place to ensure that plans / strategies are planned, delivered or changed in a controlled manner that ensures positive decommissioning and waste management outcomes.
- There is an active programme of internal assurance on projects and programmes; which considers decommissioning and waste management activities in an integrated way.

External assurance

- There is an active programme of external assurance on projects and programmes (from independent bodies, regulatory bodies etc.); which considers decommissioning and waste management activities in an integrated way.
8.7 Delivery: Supply Chain

Working with the supply chain on waste informed decommissioning projects / programmes provides access to specialist expertise, innovation and learning. Having the right relationships with the right contractors (and ensuring that they are incentivised in the right way) can ensure the delivery of waste informed decommissioning.

Use of the supply chain

- The supply chain are engaged to support delivery of waste informed decommissioning to drive innovation and enhance delivery approaches.
- The organisational culture is open to working in collaboration with the supply chain and works with strategic partners where possible.

Commercial and contract management

- Commercial arrangements with contractors to deliver decommissioning and waste management involve an appropriate level of risk sharing (pain / gain share).
- Waste informed decommissioning is delivered by partnering with the supply chain. Contractors are integrated into the organisation’s delivery teams.
- Contracts are designed to incentivise contractors to deliver successful waste management outcomes as well as effective decommissioning outcomes in line with the project strategy.
- There is early engagement with decommissioning contractors to enable effective planning and delivery.

Incentivisation

- Contracts are developed to integrate waste management and decommissioning—contractors are required to encourage optimised waste management.
- Incentives for contractors are designed to encourage optimised decommissioning and waste management.
- Contracts are let in an appropriately phased manner to enable for changes in approach or requirements based on changing characterisation data, waste inventory development etc.
- Projects and project managers are held accountable for effective waste management.
- There is reward and recognition for decommissioning project contractors to do the right thing with their wastes.
- There is an appropriate scheme of enforceable penalties built into contracts to recover funding if inappropriate or non-compliant routes are used.

Figure 17 — Waste informed decommissioning is delivered by working in collaboration with the supply chain. Tools such as supplier events (such as the pictured Sellafield Ltd procurement event) can be used to engage with the supply chain on waste informed decommissioning projects and programmes [image from Ref. 9].
8.8 Delivery: Internal incentivisation

Project teams working to deliver waste informed decommissioning need to be appropriately incentivised to deliver projects to time, cost and quality requirements in a manner which delivers the best possible outcomes for decommissioning and waste management. Projects and programmes need to be established with clear criteria relating to achieving waste informed decommissioning.

Project incentivisation

- Waste management costs are borne by decommissioning projects and programmes, to incentivise projects to care about effective waste management.
- Projects (and so project managers) are held accountable for effective waste management.
- Project success (project / programme end point) definitions include reference to effective waste management.
- Goals, targets and incentives for decommissioning projects are holistic (covering the full lifecycle, encompassing waste management).
- There are incentives for decommissioning project contractors to do the right thing with their wastes.
- There is clear demonstration of the benefits of delivering effective and integrated waste informed decommissioning.

Corporate level incentivisation

- For the NDA estate, performance based incentives (PBIs) - including longer term milestones - are designed to encompass effective waste management.
- Contractual mechanisms are used to connect decommissioning with effective waste management for the NDA estate.
- Success criteria for projects and longer term workstreams are holistic and consider waste management as well as the decommissioning aspects.
8.9 Post-delivery: Learning from Experience

The collection and analysis of learning from experience (LFE) at the end of key project phases supports knowledge management (the identification and sharing of lessons learned / good practice) and helps to inform decision making for future project phases or separate future projects / programmes.

Lessons learned

- Gathering LFE at the end of key project phases enables the progress of a project towards its success criteria to be monitored and helps to identify good practice and lessons learned which may be useful to later project phases or other projects / programmes.

- LFE gathering should involve relevant personnel from all disciplines (including decommissioning, waste management and the supply chain).

- LFE gathering should include analysis of assumptions made about projected waste volumes, waste classifications, waste routes and waste management / route costs against actual performance. Variances between projections and actuals may improve future forecasts and so support more accurate cost-estimating and scheduling for projects.

- LFE gathering and sharing should consider schedule implications, such as whether the preferred waste management route take longer to use than estimated (impact on overall decommissioning project) or in less time (allowing the project to be accelerated).

- LFE should be made available to others (see section 8.11).
Successful waste informed decommissioning relies on having the right people available with the right skills, experience and qualifications at the right time. Ensuring that decommissioning projects are appropriately resourced and have access to the right expertise for waste management supports the achievement of the right outcomes for decommissioning and for waste management.

Culture

- There is recognition that decommissioning and waste management are integrated aspects of the site mission from the top of organisations. This is stated in the core values of the organisation through standards, policies, mission and vision.

- The whole organisational senior and executive management “walk the talk” on this, and drive waste informed decommissioning from a senior level.

- The whole organisation has awareness of and supports the organisational mission / vision, and the importance of waste informed decommissioning.

- There are clear and shared expectations for the delivery of waste informed decommissioning. These are reinforced and visible to the whole organisation.

Organisational Structure

- Teams are integrated with decommissioning and waste management personnel in the same team or accountable to the same part of the organisation. There are common drivers and objectives for the team; although with adequate independence to enable clear decision making on key areas of responsibility.

- There are clear reporting lines and accountabilities defined for roles within such integrated teams, and these are worked to.

- There is collaborative or partnership working with other organisations (e.g. other waste producers or the supply chain) to drive innovation and the sharing of learning.

- Where practicable, some personnel are ideally retained across the lifecycle of a facility (from operations to POCO to decommissioning) to support knowledge retention and sharing.

Communications

- All levels of the organisation (at an appropriate level of detail to their role) are aware of strategies and plans to deliver waste informed decommissioning at a corporate and project level.

- All levels of the organisation are aware (at an appropriate level of detail to their role) of the status of projects and progress towards goals to deliver waste informed decommissioning.

- There is appropriately wide and effective dissemination of good practice and lessons learned.

- A range of communications tools are used to engage within and outwith project teams.
Communications are used to drive the culture and necessary behaviours for successful delivery of waste informed decommissioning

The culture is open, enabling personnel at different levels of the organisation to interact and input.

Training and qualification

Personnel across the business are trained and competent in waste informed decommissioning (i.e. principles of decommissioning, waste management and their relationship) to a level suitable for their role; and training refreshed as needed over the project lifecycle. The workforce is suitably trained and qualified to put the principles of waste informed decommissioning into action.

Project teams are suitably SQEP in project management, decommissioning and waste management.

Team members are cross-trained (multi-skilled) as far as practicable. Specialist team members have adequate training and qualification in the other specialisms to have an appropriate level of awareness of the drivers and requirements of the wider team (e.g. waste management specialists are trained in decommissioning and project management).
8.11 Enablers: Knowledge Management

Waste informed decommissioning relies on the sharing of knowledge, good practice and learning relating to decommissioning and waste management. Effective knowledge management enables successful approaches to be deployed on projects and mitigates against unsuccessful approaches being used.

**Systems and tools**

- There are systems and tools available across the nuclear industry to support knowledge management for waste informed decommissioning. These are free-to-use, user-friendly and accessible to all in the industry (including contractors and the supply chain); and there are demonstrable benefits for use of such systems that are understood by relevant stakeholders.

- Case studies, good practice, lessons learned and information on waste informed decommissioning are available and readily shared across the industry. There is a network of “relevant experts” who can provide advice and guidance on waste informed decommissioning.

- Tools, systems and repositories of information are maintained and kept up-to-date.

- There is ready exchange of information around the nuclear industry on the benefits and approaches for waste informed decommissioning (from where it has been deployed on projects and programmes). This includes information on technical approaches and their success in different environments.

- Knowledge management tools includes methods to share benefits and appropriate approaches for benefits realisation.

**Knowledge management culture**

- There is a culture of sharing information on good practice, lessons learned, benefits, risks, approaches and technologies across the nuclear industry.

- Knowledge sharing is an embedded and integral part of delivering waste informed decommissioning.

- Knowledge sharing involves practitioners as well as experts.

**Communities**

- There is an active community of practice for waste informed decommissioning across the industry, which delivers the sharing of industry practice across the UK.

- The community of practice supports the development and implementation of approaches for waste informed decommissioning, sharing relevant information between themselves on good practices and learning.

- There are links to relevant international fora and networks of practitioners / experts.
8.12 Enablers: Stakeholder Management

Stakeholders—whether internal or external to a project or site—are important to the successful delivery of waste informed decommissioning. Stakeholder support for a project can help to remove barriers to successful delivery. Appropriate and timely engagement with stakeholders (at a level and time relevant to the project) can help projects to gain and maintain stakeholder support.

External and internal engagement

- External and internal stakeholders with an interest in the decommissioning activity are identified at the outset of a project.
- Planning for stakeholder engagement is undertaken at an early enough stage to ensure that the right stakeholders are engaged at the right time of the process and in the right ways.
- Engagement with stakeholders is done at suitable project phases, repeated as required and in a transparent manner. Appropriate ways of engaging with stakeholders (such as through the use of social media, visits and interactive displays) are sought. There is regular and relevant progress update to stakeholders throughout the process as required.
- The aims, objectives, benefits and desired outcomes for decommissioning projects (including waste management objectives and plans) are clearly articulated from the outset. The views of relevant stakeholders is sought from the earliest practicable stage to these.
- Stakeholders recognise and value the relationship between decommissioning and waste management.

Benefits and risks

- Benefits and risks for a given decommissioning project are clearly articulated to relevant stakeholders at appropriate times in the project lifecycle.
- Stakeholders understand the benefits and risks of the approach as relevant to their role.

Stakeholder motivation

- There are appropriately communicated common outcomes and objectives that all stakeholders are motivated to support and deliver.

Figure 23 — Stakeholder engagement sessions at the beginning, during and at the end of projects can be a useful tool for communication with internal and external stakeholders; such as the pictured stakeholder session at the conclusion of the LLWR Vault 9 construction project [image from Ref. 6].

Figure 24 — Tools such as brochures and publications, such as this from Magnox Ltd. Describing the progress and plans for the SGHWR project at the Winfrith site, provide internal and external stakeholders with information about the objectives and progress of decommissioning projects [image from Ref. 12].
8.13 Enablers: Policies, Strategies and Regulation

Policy, strategy and regulation sets the basis for decommissioning by defining the expectations on a national or corporate basis. Waste informed decommissioning is supported by clearly defined and articulated policy and strategy, at different levels across a business, which communicates the expectations for how decommissioning should be delivered.

National Policy and Strategy

- There are government policies and strategies for management of radioactive wastes.
- For the NDA estate, there is a national strategy for decommissioning for the UK articulated in NDA Strategy III. There is a direction of travel, within the NDA Strategy III, for development of an integrated radioactive waste strategy.

End states and end points

- Interim and viable end states or end points for decommissioning projects and programmes are clearly defined, and these define expectations for waste management within the context of the end state.
- End states for projects, programmes and sites are understood by those involved and relevant stakeholders.

Regulation

- Regulators are bought into and promote the waste informed decommissioning approach. Regulation is proportionate to enable delivery of waste informed decommissioning.
- Regulators work together to input to plans for decommissioning and waste management.
- There is a consistent regulatory message on waste informed decommissioning.

Organisational policies and strategies

- Organisational waste management strategies are specifically linked to (and integrated with) the organisation's decommissioning strategy. These strategies feed directly into the delivery of waste informed decommissioning.
- Organisational policies and strategies are consistent with and link to national policies and strategies.
- Organisational policies and strategies require the delivery of waste informed decommissioning.
- There is a common set of standards, practice and approaches for the delivery of waste informed decommissioning, which are shared with relevant stakeholders.
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