



Magnox South

2008/09 Lifetime Plan Supporting Volume
**Technical Baseline and Underpinning
Research & Development**

Revision Register

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TITLE: Technical Baseline and Research & Development Document

Hinkley Point A Site, Lifetime Plan 2007/2008.

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1 Introduction

This section of the Lifetime Plan (LTP) submission, the Technical Baseline and Research and Development (TBRD) document, is to provide an overview of Hinkley Point A's (HPA) technical baseline and research and development work that supports the approach to decommissioning for the remainder of the site's lifecycle.

As part of Magnox South reactor sites, HPA is now engaged in decommissioning and cleanup activities with the site's remaining lifecycle described in the TBRD document in four phases:

- Defuelling – completed at HPA
- Care & Maintenance Preparations (C&M Preps)
- Care & Maintenance (C&M)
- Final Site Clearance (FSC) and re-use.

1.1 Approach to Decommissioning

Magnox Electric Ltd, as the Site License Company (SLC) operating the Magnox South nuclear licensed sites, including HPA, is responsible for developing and implementing decommissioning and waste management strategies consistent with the requirements and overall national strategy of the NDA (ref 1) and in accordance with relevant Government policies.

This TBRD document represents the HPA site specific implementation of the current strategy agreed by Magnox Electric Ltd Board for the Magnox South business. Work will also be carried out with the Decommissioning Strategy Organisation (DSO), which has been established in Magnox South to carry out research and development work on key waste management and decommissioning issues. The output of this work will underpin and further develop the current technical baseline strategy to be implemented at HPA

1.1.1 Decommissioning Principles

The following principles guide development of Magnox Electric's strategies and plans for decommissioning and waste management that are subsequently implemented at the sites, including HPA:

- The safety of the public and the workforce, together with protection of the environment, are of paramount importance and will be considered ahead of all other factors.
- Strategies will be compliant with legislation, be in accordance with Government, NDA and Company policy [1 & 2], and take due account of stakeholder views and regulatory and industry guidance.
- The priority associated with Decommissioning and Waste Management Strategies will be informed through evaluation of current Safety and Environment Detriment (SED) values and the future reduction of these based on the application of the individual strategies.

- Preferred strategies will be identified in a systematic, consistent and auditable manner using best available scientific, engineering and economic knowledge and taking account of socio-economic and political factors, risk and uncertainty. A wide range of options will be considered. The results of stakeholder engagement will be fed into the decision-making process.
- Strategies will maintain a flexible approach so as not to prematurely foreclose options, thereby maximising the capability to accommodate changes related to, for example, technical and regulatory developments or waste repository availability. However, all strategies will have a clearly identified exit route that is currently capable of implementation.
- Strategies and plans will be regularly reviewed to ensure they remain fit for purpose, learning from experience and taking account of emerging technologies through a continuing Research and Development programme.
- Strategies, plans, processes and technologies will deliver value for money for the liability owner over the remaining lifetime of the reactor sites.
- The quantities of radioactive and otherwise hazardous waste arising during the course of decommissioning will be minimised, as far as reasonably practicable.
- Radioactive waste for which there is no currently available, appropriate disposal route will be placed into a passively safe state. Where it is appropriate to package this waste, it will be placed in a form suitable for interim surface storage consistent with the requirements of the relevant disposal organisation e.g. Radioactive Waste Management Directorate (RWMD).
- Throughout any decommissioning deferral period the sites, including any remaining radioactive waste, will be managed to maintain a passively safe state that minimises the need for control and safety systems, maintenance, monitoring and human intervention.
- Where any decommissioning or waste management work is to be deferred, appropriate knowledge and records will be retained and maintained throughout the period.

1.1.2 Main Objectives

The approach to decommissioning at HPA has also been aligned with Magnox Electric Ltd's key objectives in development and implementation of decommissioning and waste management strategies, which is to;

- Ensure the continued safety of the public, the workforce and the protection of the environment.
- Deliver systematic and progressive reduction of hazards on-site.
- Achieve an appropriate balance in the use of environmental, social and economic resources both now and in the future.
- Clear and delicense the site or to achieve other such end state as agreed.

HPA site has developed their detailed TBRD in accordance with the Company's waste management and decommissioning strategy. This is based on the submission to HSE for the quinquennial review (QQR) [3] in 2000. The QQR submission was updated in 2005 to a Company Standard [5] agreed by the Magnox Electric Board in 2005.

It is recognised that the HPA TBRD may not represent the optimum solution in some areas. Therefore the R&D proposals are expected to provide opportunities for acceleration and/or optimisation of the clean-up process. This approach is consistent with industry best practice and current technologies that also take account of stakeholder expectations.

1.2 Current Status

HPA ceased generation in 1999 and completed defuelling in November 2004 when the site moved into the C&M Preps phase.

Dismantling HPA comprises three main areas of decommissioning work:

- Conventional area – containing non-radioactive plant and buildings (turbine hall, cooling water pump house, workshops and offices etc.);
- Radiological Controlled Area (RCA) – including a number of buildings with internal plant and structures that are contaminated with radioactive substances (e.g. cooling ponds, operational waste storage facilities, radioactive effluent treatment plant, active drains, aqueous decontamination facility (ex laundry) and workshops etc.)
- Two reactor buildings (also within the RCA) – each containing one nuclear reactor of the gas-cooled, graphite-moderated, Magnox type. Each reactor building also houses activated material within dedicated storage voids within the bioshield

This document expands on the current baseline for the technical approach to work that has already been planned and costed and on which current plans are based. Technical work techniques are governed by environment, health and safety legislation and all work undertaken will comply with the relevant regulations: HPA has a comprehensive infrastructure in place including independent verification to ensure high performance standards and that compliance with the requirements is maintained. Expert resource in these fields together with Core Competence, Design Authority Intelligent Customer capability is maintained. An overview of the work is given below:

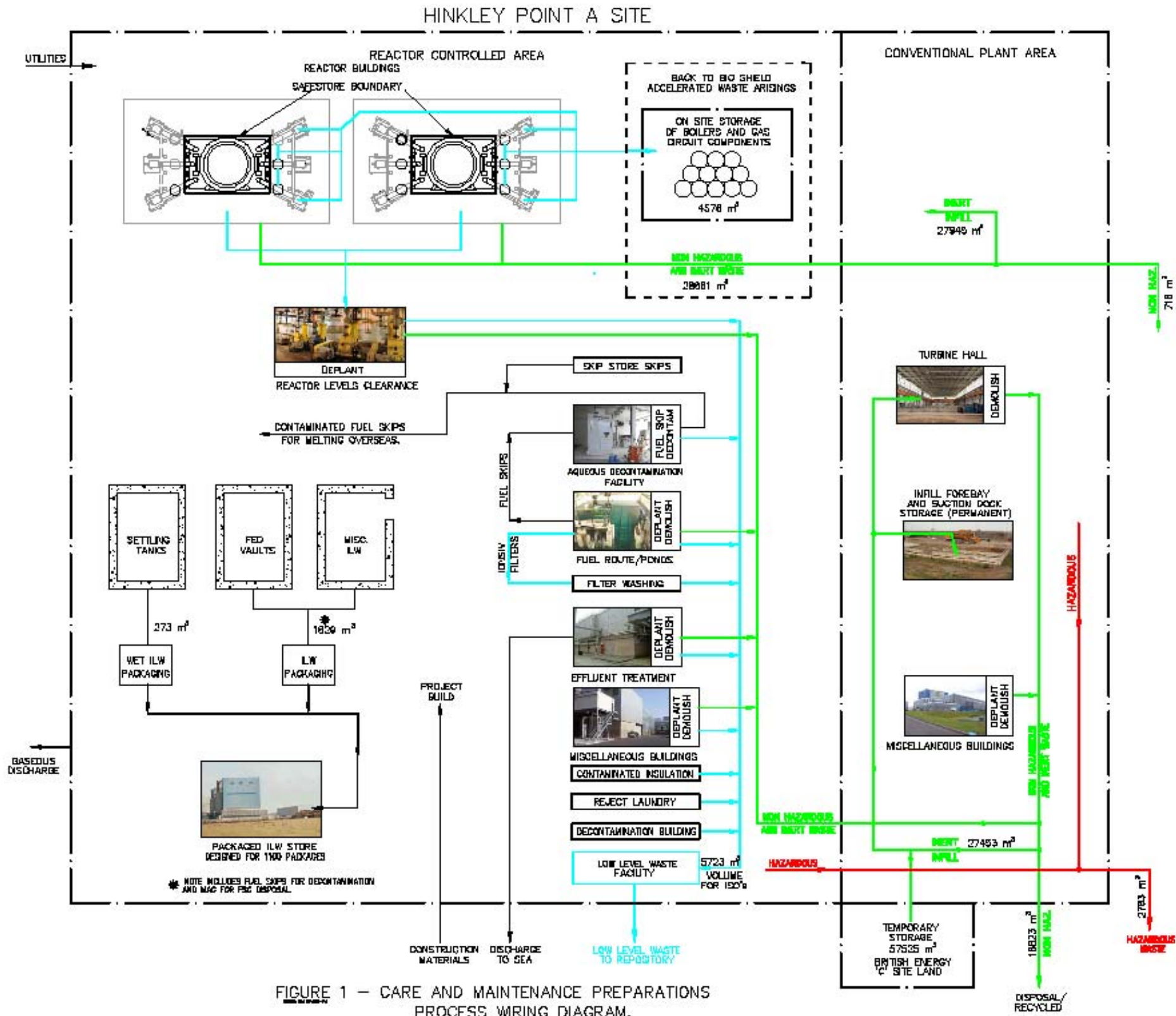
1.2.1 C&M Preps Phase:

The site is now in the first stage of site decommissioning, C&M Preps, where all buildings except the Reactor Bio-Shields, a newly constructed Intermediate Level Waste (ILW) store and a newly constructed Electrical Sub-Station will be removed from Site. The planned work for this phase includes the following:

- The prompt encapsulation of retrieved operational Intermediate Level Wastes (ILW) and placement in an on-site store pending the availability of an off-site repository or alternative facility.
- An operable fire suppression system during the retrieval of material from the dry Magnox vaults.

- Ponds decommissioning including: the removal of fuel and contaminated material, retrieval and decontamination of pond skips, pond drain and bulk decontamination of the pond structures leading to final demolition of the pond buildings.
- The deplanting and demolition of the buildings within the radiological controlled area.
- Deplanting of all reactor building components and structures, back to the bio-shield. Boilers and contaminated primary gas circuits will be retained on site (laid-down) until disposal paths are established.
- The deplanting and demolition of the buildings within the non-reactor/conventional area of the site.
- Development and implementation of a management strategy for any contaminated ground.
- Safestore preparations. Preparing the site and the few buildings remaining at the end of the C&M Preps period, for the quiescent C&M period by ensuring the buildings are weatherproof, secure and have installed the appropriate monitoring and security systems.
- Installation of new Electrical and C&I Overlay systems. The existing systems are complex and cover the whole site. Such systems are reaching the end of their working life in some cases and will not facilitate safe and effective decommissioning progress. New systems will therefore be employed to provide a solid basis for site decommissioning.

To support the work during the C&M Preps period it may be necessary to construct a number of new, mainly temporary, facilities either within existing buildings or as new buildings. These may be necessary for the retrieval, processing, packaging and storage of operational ILW, and for the management of the significant quantities of low level radioactive waste (LLW) that results from the dismantling and demolition work. Such new facilities, other than any ILW store, will be removed at the end of the C&M Preps period.



1.2.2 C&M Phase:

Following the completion of the works associated with C&M Preparations scheduled for 2030 (LTP08), HPA will enter Care and Maintenance (C&M), a specified period where the site stays in a passively safe, quiescent state and during which no significant dismantling work occurs. This phase permits the levels of radioactivity on site to reduce by decay and consequently allows the radiological benefits to be accrued from the deferral of the final dismantling activities. Throughout the C&M phase, provision will be made for surveillance and security, radiological and environmental monitoring and programmed inspection and maintenance of the buildings remaining.

The C&M period at the site is currently planned to continue to 2095.

A National Intermediate Level Waste Repository (NILWR) is assumed to become available during 2040, for the disposal of ILW from HPA. It is proposed that waste from ILW Store will be transferred to the national repository during the period 2046 to 2049. Following emptying of the ILW Store the building will be decommissioned and demolished. It is a condition agreed with the local planning authorities, that the on-site ILW store will be removed within three years of the NILWR being available.

The main activities undertaken during the C&M period will be to undertake appropriate monitoring, surveillance, inspection and maintenance of the site to ensure that it remains in a safe and secure condition. Funding is included in the LTP to provide for roof and cladding replacement after a 30 year period. However, as the site will be in a passively safe state, in accordance with the principles of passive safety, the need for maintenance, monitoring and other human intervention is minimised.

The plans for the C&M period at HPA have not yet been finalised, nor have the Regulators approved them, particularly in respect of the level of site occupancy. A cautious approach has therefore been taken and the need for a transitional period at the end of the C&M Preps phase has been accommodated in the plan. During this time, it will be necessary to demonstrate the continuing safety and security of the site prior to fully entering the C&M period when site occupancy can be reduced to a minimum level.

During the C&M period, HPA will remain a nuclear licensed site subject to nuclear site licence conditions and independent regulatory scrutiny to ensure that safety, environmental and security standards remain high.

As part of the Lifetime Plan, HPA will undertake optioneering work for acceleration of work scope from the C&M and FSC phases. This work will include potential for early boiler removal & disposal, in addition to accelerated final site clearance studies to examine the feasibility and methodology of early FSC. A key enabler to early FSC is provision by NDA of off-site storage or final disposal for ILW packages.

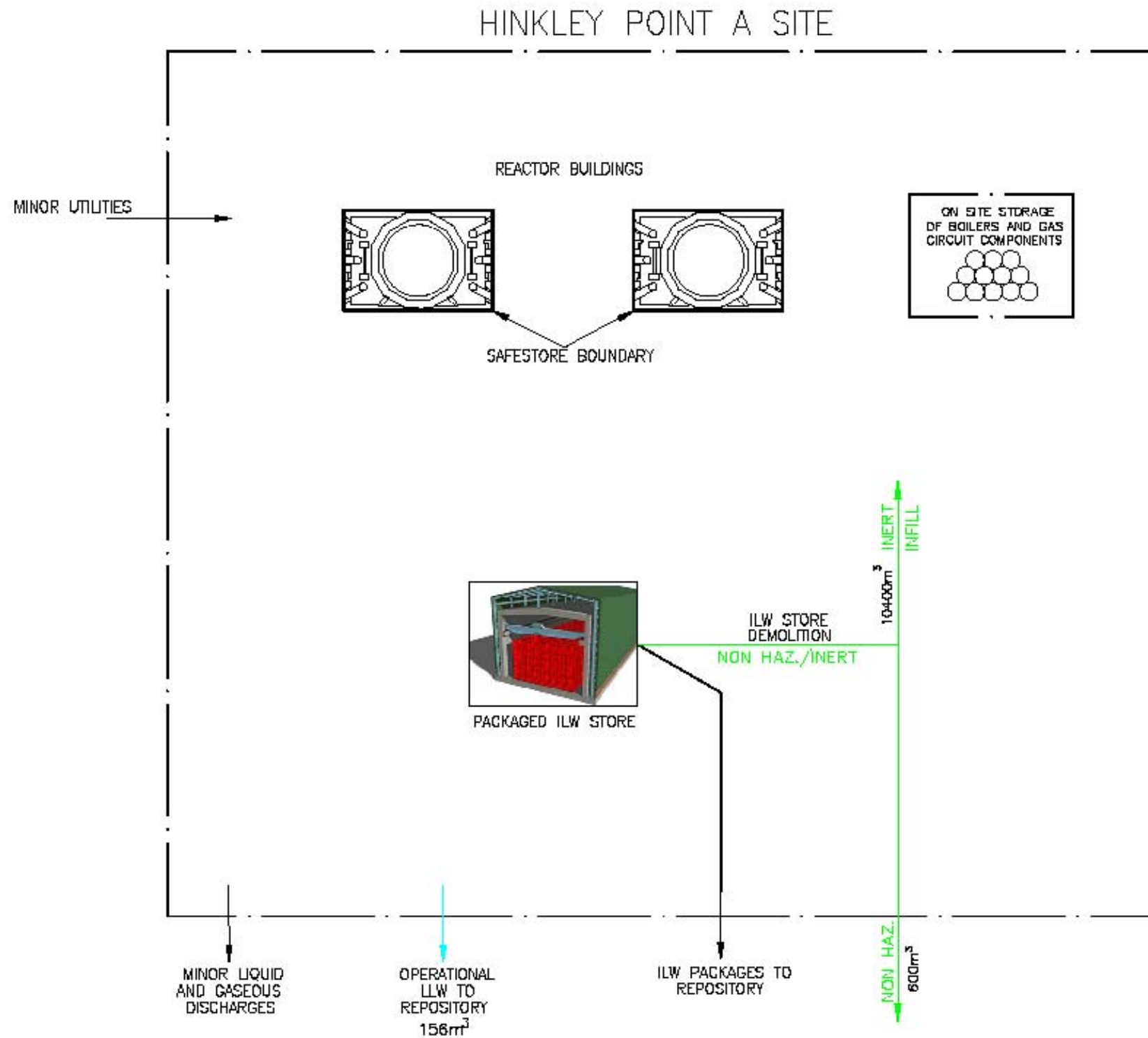


FIGURE 2 – C & M PHASE PROCESS WIRING DIAGRAM
BASED ON 70437-03

1.2.3 FSC Phase:

Final Site Clearance (FSC) is scheduled to commence, with a year of preparatory works, in 2094 following the quiescent C&M phase. The site will begin full dismantling and remediation, which will result in the site being delicensed and available for future use by 2104. The exact end point for the site is yet to be agreed, but for the purposes of this TBRD, it is assumed to be a fully delicensed site for future re-use.

In order to progress the decommissioning of the reactors and bio shield structures it will be necessary to install new site infrastructure facilities, e.g. offices, workshops and waste treatment plants.

The proposed technical baseline for FSC is currently planned to take place between 2095 and 2104, however as previously discussed, HPA is assessing options that would allow for acceleration of FSC activities.

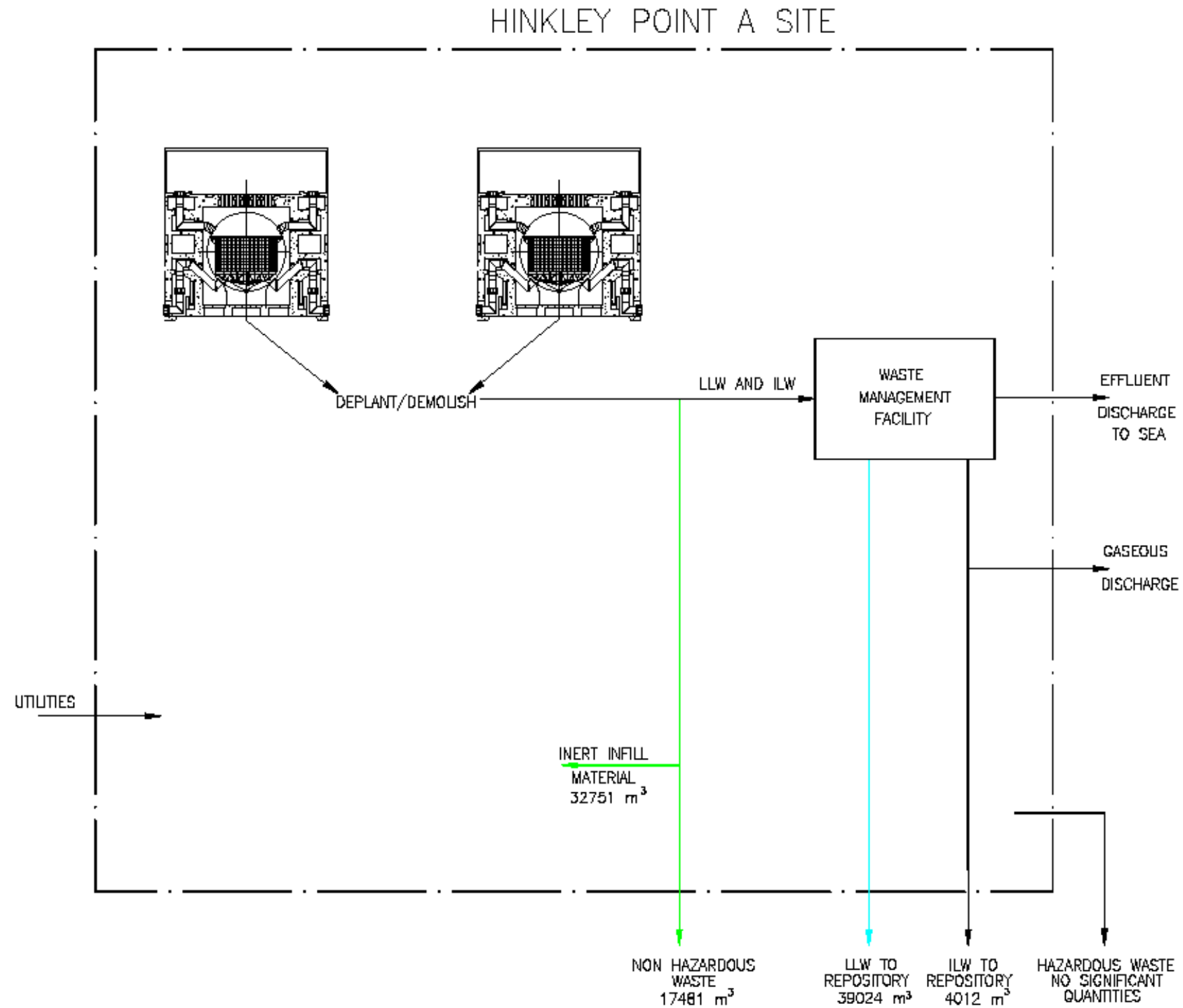


FIGURE 3 – FINAL SITE CLEARANCE PROCESS WIRING DIAGRAM
BASED ON 10420-14

1.3 General Assumptions

- Government policy and standards, together with the legislative and regulatory environment, remain unchanged, or changes pending have no significant impact.
- Strategies will be optimised against all relevant factors as required by Government Policy.
- Regulators will continue to adopt a consistent and proportionate approach.
- Strategies reflect only currently available technologies.
- Sufficient SQEP resource exists nationally to undertake the scope of work.
- Sufficient external licensed hazardous material and special waste disposal facilities will be available to receive all hazardous material requiring removal from the site.
- The National Low Level Waste Repository (NLLWR) conditions for acceptance continue to apply unchanged; when this facility reaches the end of its working life, an alternative and equivalent site will be available.
- For planning purposes only, an RWMD deep waste repository for ILW will be available in 2040. However, the timing of actual waste disposal from any particular site will be some time after 2040. ILW disposal will be subject to a national prioritisation framework yet to be developed.
- There will be a reasonably practicable interpretation of the ‘no danger’ clause in the Nuclear Installations Act 1965 (as amended) so as to facilitate delicensing.

The validity and implications of these assumptions are kept under ongoing review.

1.4 Key Site Assumptions

The key assumptions for HPA site include:

New construction projects:

- That a dry vault fire protection system will need to be installed and in service prior to receiving permission to disturb the Magnox FED contained therein.
- ILW waste will be immobilised and stored in RWMD boxes in the ILW store until the RWMD Repository is available to take HPA ILW wastes.
- The Reactor buildings will require re-cladding every 30 years.
- The Regulators will apply permissioning hold points at key stages – clearance of these hold points will be received within three months of submitting a request

Decommissioning & Termination:

- That all reactor building components and structures will be deplanted back to the bio-shield.

- Boilers and contaminated primary gas circuit components will be retained on site (laid down) until disposal paths are established.
- Boiler blower house structures and floors will be free of contamination following deplanting.

Waste & Nuclear Materials Management:

- That all existing waste management routes remain available for all identified waste forms.
- The NLLWR will accept increased volumes of waste and increased activity limits for certain radionuclides and groups of radionuclides from 2007.
- The NILWR will be available to take HPA ILW between 2046 & 2049.
- There will be no further reduction in Radioactive Substances Act (RSA) discharge authorisation following the December 2005 re-authorisation.
- Where BPEO and BPM studies identify the need to elevate an existing discharge authorisation this will be revised within 12 months of submitting the request.

The validity and implications of these assumptions are also kept under ongoing review.

1.5 Risk Management Overview

HPA's processes and policies with respect to Risk Management ensure compliance with NDA procedure PCP-10 [62]. They are intended to develop a risk awareness environment and culture on the site. This supports continual improvement, sharing of lessons learned and good practice throughout the HPA decommissioning programme.

The HPA Risk Management processes incorporate the following elements:

- Identifying risks
- Assessing risks
- Managing risks
- Reviewing risks
- Reporting risks

Specifically the TBRD risk is managed through the following framework:

- Technical risks are identified with respect to the technical maturity of the approach, the uncertainties associated with the task and factors that could influence successful completion.
- Evaluate risk impact and probability of occurrence and prioritise.
- Development of mitigation plans to minimise risk occurrence or impact and contingency plans should risk materialise during project execution.

- Project cost includes contingency funding relative to the risk associated with project execution.
- The risk associated with a technology and any supporting R&D work is referenced and managed through the DV for the delivery of that work.

2 Technology Successes

To further demonstrate the importance of technology and technical support to the delivery of the HPA Lifetime Plan, this section details some of the successes that have been achieved at the site over the last year that were supported wholly or significantly by technical input.

- Research and development trials test rig for dry vault retrieval arm and end effectors installed on R2 pilecap – Waste Retrieval Arm has successfully completed commissioning trials.
- Optioneering completed for Wet Waste process and packaging, thermal vitrification type technologies selected.
- Resin retrieval from various PWTP, CTP & AETP completed trialling and developing tools and techniques for future resin recovery operations.
- Sampling and characterisation of FED material stored in R1 & R2 wet vaults
- Successful modification and deployment of a mini digger in R1 ponds to support desludging operations within the despatch bay and transfer tunnel.
- Successful operation of the Aqueous Decontamination Facility (ADF) with ~350 of ~1734 pond skips processed.
- Transfer of contaminated metal skips for metal melting and recycling for reuse in the nuclear industry.

3 Good Practice

In the past year HPA has both initiated and adopted a number of good practices. These have been shared with other Magnox South Sites through project closeout procedures and peer group meetings. For HPA, this includes the following:

- Development of generic Baseline Technical Strategy and R&D documents throughout the year to support the LTP08 submission.
- Development of of the MCP/99 suite of documents following initial use during shadow working.
- Development and roll out of technical training for Core Competence, Design Authority and Intelligent Customer roles and responsibilities in support of shadow working and relicensing.
- Trial transfer of contaminated pond skips to the United States for recycling by metal melting, for reuse in the nuclear industry, has underpinned this approach as the BPM

solution for contaminated metals over the current baseline – disposal to the National LLW Repository.

- Modification of working practices during deplanting, decontamination and size reduction to improve productivity and reduce secondary waste arisings. By improving tools techniques and processes work which would normally need to be carried out in C4 conditions (air fed suites) has been delivered safely working in C3 (coveralls and respirators). This reduction in contaminated working conditions reduces the time required to prepare workers to enter the area, increases the number of workers available for an entry, improves their efficiency, reduces worker stress and reduces the secondary wastes generated as a result of each entry. It is assessed that for the effort expended to achieve 1 hour working in C4 conditions 3.6 hours can be delivered in C3, it is estimated that this has saved approximately£1.83M in delivering this years liability reduction together with the associated schedule saving. These working practices are delivering benefits for work covered within task identifiers 4.3 – *Retrieval and Processing of Pond Skips* and 7.3 – *Radiological Deplanting and Decontamination*. See ref 121.
- Optioneering the best technology for processing the HPA inventory of Wet ILW [86]. Recognised by the Regulators as being an industry leading example as to how to define the problem in the right framework to enable development of a selection of appropriate technologies to the selection of a robust underpinned solution.

4 Technical Baseline Table

The Technical Baseline Table for HPA is presented in Tables 1 (work that is progressing in FY 2008-09), 1A (work that is on-hold for FY 2008-09) and 1B (work that has been completed or deleted) in accordance with NDA guidance given in PCP07. The tables provide:

- A description of each major task associated with the current Baseline, with an overview of the proposed technique to be used in carrying out the work.
- Key technical assumptions explaining why the particular process has been chosen and where it has been used before.
- Technical constraints, such as infrastructure, that may limit the application of the technique.
- Areas where further work is required to underpin the proposed processes.

Tables 1 and 1A also provide HPA's judgement of Technology Readiness Level (TRL) as a guide to maturity or readiness of the proposed technique or process. NDA has defined the TRL scale between 1 and 9 (see Appendix 1). Justifying a TRL of 9 requires that the technique or process be proven through successful operations and that reliability and maintainability have been demonstrated. If a TRL of 9 cannot be justified, the gap is identified as an R&D requirement.

This development work will then support improvement of the technology maturity categorisation and the subsequent reduction in risk. It will include, for example, pilot and full scale trials, e.g. trials to be conducted on ILW retrieved from the vaults.

This also supports continual improvement in HPA's technical performance with respect to identifying, developing, implementing and sharing good practice for innovations and opportunities to improve the current site baseline in terms of time and cost, safety and environmental impact.

Tables 1 and 1A are divided into the areas of decommissioning work detailed in the LTP with the entry reference number matching the CWBS number of the detailed work package.

Table 1B identifies and records any significant changes to the Technical Baseline during the previous year and as such performs a configuration control function for the Technical Baseline.

Red italic text signifies additions and changes to the text in the tables since the previous issue.

5 Research & Development (R&D) Table

The HPA R&D requirements in support of the Technical Baseline are presented in Tables 2 (work that is progressing in FY 2008-09), 2A (work that is on-hold for FY 2008-09) and 2B (work that has been completed or deleted) in accordance with NDA guidance given in PCP07. The R&D requirements are described as:

- Activities needed to underpin the current Baseline (needs or risk management).
- Innovative R&D activities initiated by HPA in support of acceleration and/or further optimisation of the Baseline (opportunities).

The R&D tables 2 & 2A set out the technical need, explaining what has to be done and why, putting the technology gap into context. They provide the key outputs expected from the R&D proposals and set out, at high level, how these outputs will be used. In addition, dates are given when the solution should be in place to allow successful action on the Lifetime Plan (which will be after the expected R&D delivery date), together with the approximate cost of delivering the completed R&D bounded in four ranges:

<£50k
£50k - £100k
£100k - £1M
>£1M

Table 2B captures the changes to the R&D identified in the previous submission, specifically those which have been completed or deleted. As such provides a configuration control function for the HPA R&D activities.

Red italic text signifies additions and changes to the text in the tables since the previous issue.

5.1 Nuclear Research Schedule Work

The Decommissioning Strategies Organisation (DSO) and the Reactor Waste and Decommissioning Technology Group (RWDTG) have a major role of oversight, development and management of Waste and Decommissioning Research and Development (W&D R&D). The group provides strategic direction and oversight of Magnox Electric's generic W&D R&D programme by:

- Directing a coordinated and cost effective R&D programme within the "Reactor Sites" in support of radioactive waste management and decommissioning issues.

- Providing an inter-site forum for Magnox Electric Limited for the sharing of technology development work undertaken and led from individual sites.
- Directing the balance between longer term R&D and the needs for more immediate individual site demands.
- Providing a strategic input into R&D programmes.
- Overseeing the preparation and delivery of the Licensees' Nuclear Research Schedule (or its replacement) on an annual basis.

The specific generic work that supports HPA site's technical baseline and R&D programme by developing the TRL and the mitigation of technical risks is referenced in the R&D Tables 3 of this document. More detailed information is contained in the R&D table of the Magnox Electric Limited Waste and Decommissioning Research & Development Programme document.

Table 3 replicates the format of Table 2 described above, Tables 3 (work that is progressing in FY 2008-09), 3A (work that is on-hold for FY 2008-09) and 3B (work that has been completed or deleted).

Red italic text signifies additions and changes to the text in the tables since the previous issue.

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Appendix 1 NDA Guidance from PCP-07

Technology Readiness Levels Table (TRL)

Basic Technology Research	Level 1	Basic principles observed and reported
Research to Prove Feasibility	Level 2	Technology concept and/or application Formulated
Technology Development	Level 3	Analytical and experimental critical functions and/or characteristic proof of concept
Technology Demonstration	Level 4	Component and/or bench validation in laboratory environment
System/Subsystem Development	Level 5	Component and/or bench validation in relevant environment
System Test & Operation	Level 6	System/subsystem model or prototype demonstration in relevant environment
	Level 7	System prototype demonstration in an operational environment
	Level 8	Actual system completed and qualified through test and demonstration
	Level 9	Actual system proven through successful operations e.g. through reliability and maintainability demonstration in service

Table 1: Hinkley Point A - Technical Baseline (Work that is progressing in FY 2008-09)*Red italic text signifies additions and changes to the text in the tables since the previous issue.*

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
1.0 1.1.1.24.11.12.2 4035.24021 1.1.1.24.13.34.2 4025.24056	Wet ILW - Retrieval & Processing							Refs: 2, 3, 13, 14, 15, 16, 19, 21, 25, 28, 29 & 30 MEL W&D R&D Wet ILW
1.1	Sludge & Resin Retrieval and Conveyance Equipment		<p>The retrieval equipment is combined with a pressurised system used to convey the waste to another location.</p> <p>Conventional sludge handling tools will be used to mobilise the waste and retrieve from the current places of storage into a small pressure vessel.</p> <p>The pressurised system is used, in conjunction with existing and temporary pipework, to force the vessel contents through the pipework to a reception/process tank local to the Wet ILW Processing Facility.</p> <p>Various full-scale trials have been conducted using simulant materials to prove the technology's compatibility with the wastes currently at HPA.</p>	7	<p>That the simulants used to develop and underpin the technology are representative of the materials comprising the Wet ILW Project waste inventory.</p> <p>Wet ILW Processing Facility is fixed and remote to the tanks from which the waste is being retrieved.</p> <p>Retrieved material to be pumped to reception tank and not transferred using a bowser or similar.</p> <p><i>That HPA ILW will be conditioned and stored at HPA.</i></p> <p>That no ILW originating from other sites will be received at HPA for conditioning and storage</p>	<p>Waste is currently stored in tanks within a concrete shielded secondary containment. Access to the original tanks is very restricted and in some cases obstructed by subsequent plant modifications both of which may compromise the ability to deploy sludge and resin retrieval and conveyance equipment.</p> <p><i>Road transport containers may not be readily available for the movement of ILW between Magnox sites</i></p>	<p>Any gaps identified during the on site recovery trials may lead to a further programme of tests.</p> <p><i>Performance enhancement - Investigate pump performance through trials to increase volume flow rates and increased solids concentrations.</i></p> <p><i>Wet ILW may be exported for conditioning at other sites</i></p>	<p>Ref. 70, 71, 72, 73, 74, 75, 76, 77, 82A, 82B & 82C</p> <p>Table 2, Task ID 1.1 2 <i>Wet ILW Retrieval & Conveyance</i></p> <p>Table 3 Task ID 1.5.9 <i>DSF – ILW Transportation</i></p>
1.2	Ion Exchange Resin Soaking		<p>To prevent the IX Resin reacting Magnox South have developed a technique to pre-swell the resin prior to mixing with cement so preventing the resin material swelling further. Spent IX Resin will be pre-treated with a sodium hydroxide solution which causes the resin bead to swell so preventing a further interaction with the cement. Various trials have been conducted to assess resin swellings potential to provide a stable encapsulated waste form in order to overcome this problem.</p> <p>Spent caustic solution from resin swelling will be neutralised prior to be discharged into an active effluent reception tank.</p>	5	<p>That pre-swelling of organic resins will provide an encapsulated waste form that is ultimately acceptable to RWMD.</p> <p>Sulphur Reducing Bacteria resident in AETP tanks will not affect formulation or waste process solution.</p>	<p>Organic ion exchange resins swell when they react with cement powders, this results in the break down of the immobilised waste form and the failure to satisfy RWMD packaging requirements.</p>	<p>An R&D programme has been undertaken to underpin the waste encapsulation formulation to substantiate the RWMD LOC process. The long term stability trial for this is still ongoing.</p> <p>Alternative waste packaging solutions for IX Resin providing improved waste loading and improved waste form stability.</p> <p><i>Behaviour of IX Resins during immobilisation processing.</i></p>	<p>Ref. 35, 78, 79, 80& 83</p> <p>Table 2, Task ID 1.2.2 Organic resin packaging solution.</p> <p>Task ID 1.2.3 <i>Assess results of failed resin packaging trials.</i></p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
						Deferring decommissioning activities requires more staff to become familiar with the concept and processes for solidifying IX Resin wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future.	Knowledge management – capture of current knowledge and understanding regarding process and encapsulation requirements for the future.	Table 3 Task ID 1.5.10 RWDTG scope element S30/07 Handbook of the processing and immobilisation of organic IX resin wastes
1.4	Managing Waste Water Arisings		Existing tanks and process vessels for activity abatement and filtration will be modified from their current service to similar service for the new process. It is likely that the existing Active Effluent Treatment Plant will remain largely unchanged and that the arisings from the new process will be fed into a designated tank from which the liquor can be drawn for processing prior to discharge.	7	That the future waste water arising will be chemically compatible with the AETP capability. That sufficient tanks will still be available for reuse following the Sulphur Reducing Bacteria attack of the active effluent system.	Existing plant layout and configuration. Use of existing abatement IX Resins	Assessment of waste water arising following selection of selection of BPEO for waste process and packaging.	Ref: 85 Table 2, Task ID 1.4.1 Assessment of waste water arisings. Task ID 1.4.2 AETP condition.
1.5	Dewatering & Encapsulation		The dilute slurries required to convey the Wet ILW to Process Facility will be concentrated using the Transportable Radioactive Sludge Dewatering Unit (TRSDU) to achieve optimum waste package loading prior to loading into a 3m ³ liner in the Transportable Intermediate Level Waste Solidification Plant (TILWSP) where the slurry will be mixed with pre-blended cement powders using a lost paddle technique. Once fully cured an inactive capping grout is added prior to the waste package being released for export to the ILW Store. TILWSP and TRSDU were both developed and proven over a considerable period by Magnox South. The prototype TILWSP is currently operating at Trawsfynydd to process the sites resin and sludge inventory. Operational experience from Trawsfynydd has been, and will continue to be, used to optimise design/operability/maintainability of the plant to be produced for HPA. Dialogue has been established, and will continue, with RWMD to ensure compliance with requirements. This is currently being evaluated under a design concept review and any R&D work that is identified as required will be prepared as a proposal to the NDA for consideration and approval.	7	That the Sites ILW will be processed and encapsulated on site of origin. IX Resin, sludge, sand and desiccant will all be encapsulated using cementitious material in 3m ³ RWMD compliant waste drums. Organic resin material will require pre-swelling to maximise packing density. Ongoing waste product formulation R&D will satisfy the RWMD packaging requirements for wet ILW. Sulphur Reducing Bacteria will not affect waste processing or waste product formulation. Residual reactive metals will not affect the stability of the packaged waste forms or there acceptability to RWMD <i>That HPA ILW will be conditioned and stored at</i>	Organic resin swells in a cementitious grout causing the monolith to fail. Encapsulating wet waste in cementitious grouts has the effect of bulking up packaged waste volume. Throughput capacity of process and packaging plant. TILWSP throughput currently limited by the design of the machine due to delay for package curing. <i>Waste package formulation will need to satisfy RWMD.</i>	Extant Technical Baseline not supported by BPEO study. Operational Research model for wet waste process plant to underpin throughput capability of the process. <i>Optioneering of the wet waste immobilisation techniques wrt baseline technical solution identifies thermal vitrification as offering substantial benefits. Further R&D required to develop understanding of the following topics:</i> • <i>Waste product formulation.</i> • <i>Develop approach to consents, authorisations</i>	Ref. 81, 83, 86, 87, 88, 96, 98, 101, 102, 108, 111 & 112 Table 2, Task ID 1.2.2 Organic resin packaging solution. Task ID 1.5.2 Throughput modelling. Task ID 1.5.14 Glass formulation trials. Task ID 1.5.15 Off-gas analysis

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
					<p><i>HPA.</i></p> <p><i>That no ILW originating from other sites will be received at HPA for conditioning and storage.</i></p> <p><i>That a change of wet waste conditioning process to that identified in the BPEO [86] will be sanctioned.</i></p> <p><i>That sufficient waste packages of the required design will be available to meet the processing plant needs to meet the site schedule.</i></p>	<p><i>Materials representative of the actual waste will need to be utilised in R&D trials to underpin the waste conditioning process</i></p>	<p><i>and permits.</i></p> <ul style="list-style-type: none"> • <i>Knowledge of ILW behaviour in high temperature environments.</i> • <i>Waste package performance.</i> <p>• <i>Secondary waste arisings.</i></p> <p>Knowledge and understanding of the behaviour of magnesium hydroxide colloids with respect to waste processing plant</p> <p>Existing analytical techniques with respect to ⁷⁹Se & ⁹⁹Tc are not sufficient to obtain an appropriate LoC meaning disposal routes for certain</p>	<p><i>Task ID 1.5.16 Revised discharge authorisation for Vitrification plant.</i></p> <p><i>Task ID 1.5.17 Investigate thermal decomposition of IX resins</i></p> <p><i>Task ID 1.5.18 Investigate impact performance of glass waste forms</i></p> <p><i>Task ID 1.5.19 Radiation tolerance of glass waste forms in high radiation environments.</i></p> <p><i>Task ID 1.5.20 Develop waste package design</i></p> <p><i>Task ID 1.5.21 Pilot plant – inactive trials</i></p> <p><i>Task ID 1.5.22 Pilot plant – active trials</i></p> <p><i>Task ID 1.5.23 Secondary waste arisings.</i></p> <p><i>Task ID 1.5.24 Vitrification operational plant design preparation</i></p> <p>Table 3,</p> <p>Task ID 1.5.6 RWDTG scope element S07/07 Magnesium-hydroxide colloids in ponds wet wastes</p> <p>Task ID 1.5.7 RWDTG scope element N08/07 Development of systems for ⁷⁹Se and ⁹⁹Tc analysis in ILW</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
						<p><i>Road transport containers may not be readily available for the movement of ILW between Magnox sites</i></p> <p>Deferring decommissioning activities requires more staff to become familiar with the concept and processes for solidifying IX Resin wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future.</p> <p><i>Availability of materials / commodities on the world market.</i></p> <p><i>Physical properties of magnesium hydroxide.</i></p>	<p>waste streams may not be available.</p> <p>Existing analytical techniques are not available for the qualification of all radionuclides which may be of interest to RWMD, so as to allow submission of stage 2 Letters of Compliance.</p> <p>Use of centralised waste process and the associated requirement to transport waste between storage site and process plant.</p> <p>Knowledge management – capture of current knowledge and understanding regarding process and encapsulation requirements for the future.</p> <p>Stability of organic IX Resin in cementitious grout matrix.</p> <p><i>Availability of encapsulant materials used in preparation of the design when required for waste processing campaign.</i></p> <p><i>Behaviour of magnesium hydroxide based materials during retrieval, processing and immobilisation.</i></p>	<p>for RWMD compliance</p> <p>Task ID 1.5.8 RWDTG scope element N28/07 Approaches to determine the radionuclide concentrations in ILW streams</p> <p>Task ID 1.5.9 DSF – ILW Transportation</p> <p>Task ID 1.5.10 RWDTG scope element S30/07 Handbook of the processing and immobilisation of organic IX resin wastes</p> <p>Task ID 2.4.4 RWDTG scope element N14/07 Gamma irradiation of samples</p> <p>Task ID 2.4.9 RWDTG scope element N20/08 <i>Security of material supply.</i></p> <p>Task ID 1.5.25 RWDTG scope element S04/07 Particulate science of magnesium hydroxide based materials in support of Magnox wet waste processing</p>
1.7	Facilities Housing		A facility to house the soaking / dewatering / encapsulation / despatch plant / equipment will be constructed. The facility will comprise a clad reinforced concrete structure provided with all necessary supplies and discharges, including crange to service TRSDU, TILWSP and the cross site transporter. The TILWSP & TRSDU plant, services and control container are transportable and will be loaded into the finished structure.	9	That sufficient space is available within the RCA to facilitate construction of the necessary structure. Discharge authorisations will be granted for the gaseous discharge from the vent plant.	Limited available space on the site to accommodate both TRSDU & TILWSP <i>Or alternate process solution.</i>	Understanding of available buildings and facilities for wet waste immobilisation <i>Potential siting options for a thermal vitrification type plant.</i>	Table 2 Task ID 1.7.1 Assessment for the potential to reuse existing building for wet waste immobilisation.

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
1.8	Characterisation		Currently available manual tools and techniques. Use of on site facilities and the supply chain for characterisation	9	<p>Cement Encapsulation will be wet waste immobilisation technique. (predominantly limited to radiological fingerprint and particle size distribution)</p> <p>All wastes will require a radiochemical analysis to facilitate processing and discharge for the storage location.</p>		<p>Formal arrangements for:</p> <ul style="list-style-type: none"> lifecycle management of waste samples. Analysis of samples. Reporting and management of sample analysis <p>Existing analytical techniques with respect to ⁷⁹Se & ⁹⁹Tc are not sufficient to obtain an appropriate LoC meaning disposal routes for certain waste streams may not be available.</p> <p>Existing analytical techniques are not available for the qualification of all radionuclides which may be of interest to RWMD, so as to allow submission of stage 2 Letters of Compliance.</p> <p>The volume of characterisation work may not be deliverable with the existing internal resources and supply chain</p>	<p>Ref:- 105</p> <p>Table 2</p> <p>Task 1.8.1 Lifecycle management of samples</p> <p>Table 3</p> <p>Task ID 1.5.7 RWDTG scope element N08/07 Development of systems for ⁷⁹Se and ⁹⁹Tc analysis in ILW for RWMD compliance</p> <p>Task ID 1.5.8 RWDTG scope element N28/07 Approaches to determine the radionuclide concentrations in ILW streams</p> <p>Task 1.8.2 RWDTG scope element N29/08 Radiochemical analysis</p>
2.0 1.1.1.24.11.12.2 4035.24020 1.1.1.24.13.34.2 4035.24057	Solid ILW - Retrieval & Processing	<p>Overview: During the operational lifetime of HPA Power Station, intermediate level waste accumulated in the vaults of R1 and R2 Pond Complexes, and in the NCAW basement. The Solid ILW Project consists of the design, procurement, construction, operation, commissioning and ultimate decommissioning of the necessary plant/equipment to retrieve, process and ultimately encapsulate the above material prior to its transfer to the sites ILW Store.</p> <p>The Solid ILW project deals with the removal of fuel element debris (FED) from the R1 and R2 Pond Complex vaults and other miscellaneous materials (MCI & MAC) currently stored in the NCAW basement, to storage in the new ILW store. The quantities to be retrieved, processed and stored are: 775m³ (FED); 484,000 (~1m³) Activated Nimonic Springs; 20m³ Gravel; and a quantity of MCI & MAC, all as defined within the projects Feedstock Data Report [90]</p>						<p>Ref: 11, 17, 19, 20, 25, & 90</p>
2.2	FED Retrieval and Box Loading Facility		<p>There are two sets of vaults at HPA attached to each reactors pond complex. A FED retrieval and box loading facility will be provided for each reactor.</p> <p>FED will be retrieved from the vaults using grabs deployed on a Waste Retrieval Arm based on Hydraulic loader arm technology for the dry vaults and using an Electric Overhead Travelling Crane for the wet vaults.</p>	6	<p>Fire detection and suppression system will need to be operational prior to disturbing the waste in the dry vaults.</p> <p>The existing vault/pond structure can withstand the</p>	<p>Existing openings in the dry vault soffitt are insufficient for the deployment and a new opening will need to be created.</p> <p>The wet vault soffit structure needs to be</p>	<p>Retrieval arm operability</p>	<p>Refs: 37,38, 39, 40, 41, 42, 113, 114 & 115</p> <p>Table 2,</p> <p>Task ID 2.2.1</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
			<p>An underwater ROV will also be deployed in the wet vault to manipulate the residual FED within the reach of the grab and to cut up the vault furniture. Retrieved material will be loaded onto a common sort tray, which will transfer the waste between a number of features. Waste on the tray will be inspected and levelled prior to being assayed and weighed before the contents are tipped into the waste box. Box external surfaces will be kept clean through the use of a double lidded port. Box lids will be secured and the external surfaces clearance monitored using a robot sourced from the automotive industry. Monitored packages will then be transferred to the Cross Site Transporter using an Electric Overhead Travelling Crane.</p>		<p>loading applied by the retrieval and box loading equipment.</p> <p>Retrieval solutions identified will be demonstrated as being fit for purpose.</p> <p>The retrieval machine hydraulic system will limit the force delivered by the WRM such that the vault structure can be substantiated.</p> <p>Fines will not need to be separated from the solid waste stream.</p> <p>That fuel fragments do not need to be segregated from FED prior to encapsulation.</p> <p>That the FED retrieval grab will handle the dry vault gravel.</p> <p>Visibility in the wet vault will not significantly reduce during retrieval operations.</p> <p>That the use of open geometry grapples will remove sufficient non adhered material from the FED to satisfy RWMD packaging requirements.</p> <p>That sufficient segregation of the waste tray from surrounding influences can be achieved to meet waste assay requirements.</p> <p>That the box lid will be bolted on prior to export from the FED Retrieval and Box Loading Facility and subsequent grouting.</p> <p><i>That HPA ILW will be conditioned and stored at HPA.</i></p> <p><i>That no ILW originating from other sites will be received at HPA for conditioning and storage</i></p>	<p>retained. Wet vault retrieval will need to be deployed through the available openings.</p> <p>The Pond Water Treatment Plant maintains the water quality in the wet vault.</p> <p><i>The wet vault will need to be isolated from the ponds prior to the ponds being drained.</i></p> <p>Wet vault ROV must be deployable through the existing soffit structure.</p> <p>Safety significant systems and cabling run through the vault area, the functionality of which will need to be maintained.</p> <p>No disturbance of the waste may be affected in the dry vaults without clearance by the Nuclear Safety Committee (NSC).</p> <p><i>Road transport containers may not be readily available for the movement of ILW between Magnox sites</i></p>	<p>and performance trials integrated with operator viewing system development.</p> <p>Characterise dry vault gravel.</p> <p>Identify alternative wet vault waste retrieval technology.</p> <p>Development of wet vault viewing system and deployment technology.</p> <p>Suitable technology for separating fines from the solid waste if required.</p> <p><i>FED characterisation – Physical and Radiological characteristics</i></p> <p><i>Failure mode and effects analysis to ensure potential faults can be recovered from.</i></p> <p><i>Arm strength assessments to assure the designer that potential fault loads are within the machines design load case.</i></p> <p><i>Solid ILW may be exported for conditioning at other sites</i></p> <p><i>Solid ILW may be received from other sites for conditioning and storage.</i></p>	<p>Retrieval arm trials.</p> <p>Task ID 2.2.2 Dry vault gravel characterisation</p> <p>Task ID 2.2.3 Alternative wet fed retrieval solutions.</p> <p>Task ID 2.2.7 Wet vault viewing system.</p> <p>Task ID 2.2.8 Fines segregation.</p> <p>Task ID 2.2.9 Wet vault FED characterisation</p> <p>Task ID 2.2.11 <i>Failure mode and effect analysis.</i></p> <p>Task ID 2.2.12 <i>WRM design load case assessment.</i></p> <p>Table 3</p> <p>Task ID 1.5.9 <i>DSF – ILW Transportation</i></p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
2.3	MCI & MAC Box Loading Facility		A single facility will be provided where size reduced MCI and MAC items will be marshalled prior to being assayed and loaded into boxes. Boxes will be loaded through a double lidded port using manual techniques with additional shielding and containment provided as necessary. Loaded boxes will be handled within a shielded facility where the lid will be secured and the external surfaces swabbed similar to the FED Retrieval and Box Loading Facility.	6	<p>That all solid ILW (currently stored in the NCAW) can be processed and loaded by hand into waste boxes.</p> <p>That box lids will be secured prior to transfer to the encapsulation plant and the package surfaces clearance monitored using a robot sourced from the automotive industry as above.</p> <p>It will be acceptable to use temporary shielding and containments to provide environmental and workforce protection.</p> <p>Only solid ILW will be received by the facility.</p> <p>That all ILW will need to be characterised prior to loading into waste boxes.</p> <p><i>That only ILW MCI & MAC remains stored in the NCAW basement for processing by the Solid ILW project.</i></p> <p><i>The disposal route for MCI & MAC is 3m³ RWMD boxes with the waste immobilised in a cementitious grout.</i></p> <p><i>That sufficient waste packages of the required design will be available to meet the processing plant needs to meet the site schedule.</i></p>	<p>Current knowledge of the sites waste inventory.</p> <p>Plant handling capability and structural capacity of the facilities.</p>	<p><i>A fully detailed isotopic inventory of the ILW waste currently stored in the NCAW basement is not available.</i></p> <p><i>Definition of waste acceptance criteria for the MCI/MAC facility to enable plant design to be underpinned.</i></p> <p><i>Alternative disposal routes for MCI and MAC through decontamination or reformation.</i></p>	<p>Ref: 118</p> <p>Table 2</p> <p><i>Task ID 2.3.3 NCAW waste inventory.</i></p> <p><i>Task ID 2.3.4 Conditions for accepting MCI & MAC not currently stored in the NCAW basement.</i></p> <p>Table 3</p> <p><i>Task ID 2.3.2 Deposition of WRATS and suspected orphans</i></p> <p>Task ID 4.4.1</p> <p>MEL W&D R&D Contaminated and Activated Metals.</p> <p>Task ID 7.0.1</p> <p>Concrete & Miscellaneous ILW</p>
2.4	Encapsulation & Package Remediation Facility		A single encapsulation facility will be provided for the encapsulation of the loaded waste boxes. The facility will incorporate silos for the bulk cement powders and a mixer for producing the grout. Grout will be pumped to a dispense station from where it will be metered into the waste box through a port in the box. A number of grout stations will be provided, service by an in cell electric overhead travelling crane, to meet the throughput requirements of the plant each grout station will be provided with a grout boom which will engage with the box once the crane has disengaged. The grout boom is provided with level sensors, vent extract and	6	<p>The Sites ILW will be processed and encapsulated on site of origin.</p> <p>FED will be encapsulated in 3m3 boxes.</p> <p>That superplasticisers will not be used to improve grout fluidity.</p> <p>That bleed water will need to be removed from the waste box following</p>	<p>Land and facilities within the RCA.</p> <p>The size of the encapsulation facility will be confirm following modelling of the plant throughput against objectives.</p> <p>RWMD do not endorse the use of organic superplasticisers.</p>	<p>Grout facility Operational Research (OR) modelling will be required to confirm the required number of filling stations.</p> <p>R&D trials to underpin</p>	<p>Refs: 43, 44, 45, 46, 47, 48, 102</p> <p>Table 2,</p> <p>Task ID 2.4.1</p> <p>Solid waste process and packaging plant throughput modelling</p> <p>Task ID 2.4.2</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
			<p>conditioned air supply in addition to the grout supply hose. Bleed water is removed using a conditioned air system developed for BNLS. The facility incorporates a disposal route for waste grout and grout washings. When the grout and cap process has been completed the solidified waste box will be transferred to a cap and swab position where the ports through the box will be sealed and a contamination check can be made prior to export to the ILW store in the cross site transporter.</p> <p>The encapsulation facility is also provided with a package remediation position where contaminated and non-compliant packages can be remediated prior to export, this facility will be provided with the capability to install master slave manipulators and a variety of additional tools through local ports as appropriate for the problem.</p>		<p>grouting to meet throughput requirements.</p> <p>That packages need to remain at the grout/cap station throughout encapsulation process.</p> <p>Appropriate quality and quantity of materials will be available so as not to constrain project performance and delivery.</p> <p><i>That HPA ILW will be conditioned and stored at HPA.</i></p> <p><i>That no ILW originating from other sites will be received at HPA for conditioning and storage</i></p> <p><i>Gravel from the bottom of both dry vaults will be loaded into waste boxes and grouted.</i></p>	<p>Deferring decommissioning activities requires more staff to become familiar with the concept and processes for solidifying FED wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future.</p> <p><i>Road transport containers may not be readily available for the movement of ILW between Magnox sites</i></p> <p>Materials representative of those used in R&D trials to underpin the waste conditioning process will need to be utilised during plant operation</p>	<p>grout infiltration of waste materials and identify further development requirements.</p> <p><i>A robust underpinned BPEO justification for encapsulation of solid ILW in cementitious grouts does not exist for HPA waste streams.</i></p> <p><i>Techniques for refining and recycling Magnox metal to enable its release as a saleable commodity.</i></p> <p>Stability of cemented waste subjected to Gamma irradiation</p> <p>Investigate stability of cementitious grouts using super plasticizers to improve material flow characteristics.</p> <p>Existing analytical techniques are not available for the qualification of all radionuclides which may be of interest to RWMD, so as to allow submission of stage 2 Letters of Compliance</p> <p><i>Solid ILW may be exported for conditioning at other sites</i></p> <p><i>Solid ILW may be received from other sites for conditioning and storage.</i></p> <p><i>It may be possible to treat contaminated gravel and reduce the volume of material to be encapsulated as ILW.</i></p> <p><i>Availability of encapsulant materials used in preparation of the design</i></p>	<p>Grout infiltration R&D.</p> <p><i>Task ID 2.4.6 Improved solid waste packaging solutions</i></p> <p><i>Task ID 2.4.7 Metal refining techniques</i></p> <p>Table 3</p> <p>Task ID 2.4.4 RWDTG scope element N14/07 Gamma irradiation of samples</p> <p>Task ID 2.4.5 Innovative Strategic Project managed by the DSO. Ref: 39/39056 Use of super plasticizers in cementitious grouts.</p> <p>Task ID 1.5.8 RWDTG scope element N28/07 Approaches to determine the radionuclide concentrations in ILW streams.</p> <p><i>Task ID 1.5.9 DSF – ILW Transportation</i></p> <p><i>Task ID 2.4.8 RWDTG scope element N05/08 Contaminated Gravel Treatment.</i></p> <p><i>Task ID 2.4.9 RWDTG scope element N20/08</i></p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
							<p><i>when required for waste processing campaign</i></p> <p><i>Review RWMD paper on the use of Comb Superplasticisers for applicability to Magnox South waste forms.</i></p> <p>Knowledge management – capture of current knowledge and understanding regarding process and encapsulation requirements for the future.</p>	<p><i>Security of materials supply.</i></p> <p>Task ID 2.4.10 <i>RWDTG scope element N25/08 Use of Comb Superplasticisers</i></p> <p>Task ID 2.4.11 RWDTG scope element N31/07 Handbook for the processing and encapsulation of Magnox FED.</p> <p>Task ID 2.4.12 DSF – ILW Integrated FED Solutions</p>
2.7	<i>Waste Sampling and Characterisation</i>		<i>Currently available manual tools and techniques. Use of on site facilities and the supply chain for characterisation</i>	9	<p><i>Cement Encapsulation will be solid waste immobilisation technique.</i></p> <p><i>All wastes will require a radiochemical analysis to facilitate processing and discharge for the storage location.</i></p>	<i>No on-site capability for sample characterisation.</i>	<p><i>Characterisation of all solid waste streams is incomplete</i></p> <p><i>Formal arrangements for:</i></p> <ul style="list-style-type: none"> <i>• lifecycle management of waste samples.</i> <i>• Analysis of samples.</i> <i>• Reporting and management of sample analysis.</i> <p><i>A fully detailed isotopic inventory of the ILW waste currently stored in the NCAW basement is not available..</i></p> <p><i>FED characterisation – Physical and Radiological characteristics.</i></p> <p>Representative Dry vault FED characteristics (until actual material can be sampled).</p> <p>Actual Dry vault FED characteristics.</p>	<p>Ref:- 105 & 118</p> <p>Table 2</p> <p>Task ID 1.8.1 <i>Lifecycle management of samples</i></p> <p>Task ID 2.3.3 <i>NCAW waste inventory</i></p> <p>Task ID 2.2.9 Wet vault FED Characterisation (Actual)</p> <p>Task ID 2.7.1 <i>Dry vault FED Characterisation (Representative)</i></p> <p>Task ID 2.7.2 <i>Dry vault FED Characterisation (Actual)</i></p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
					<p><i>Transport routes to alternative out of country laboratories can be made available to meet HPA sample analysis requirements.</i></p>	<p><i>Limited UK resource and laboratory space for radiochemical characterisation.</i></p>	<p>Existing analytical techniques with respect to ⁷⁹Se & ⁹⁹Tc are not sufficient to obtain an appropriate LoC meaning disposal routes for certain waste streams may not be available.</p> <p><i>Existing analytical techniques are not available for the qualification of all radionuclides which may be of interest to RWMD, so as to allow submission of stage 2 Letters of Compliance.</i></p> <p><i>The volume of characterisation work may not be deliverable with the existing internal resources and supply chain</i></p>	<p>Table 3</p> <p>Task ID 1.5.7 RWDTG scope element N08/07 Development of systems for ⁷⁹Se and ⁹⁹Tc analysis in ILW for RWMD compliance</p> <p>Task ID 1.5.8 RWDTG scope element N28/07 Approaches to determine the radionuclide concentrations in ILW streams</p> <p>Task 1.8.2 RWDTG scope element N29/08 Radiochemical analysis</p>
<p>3.0 1.1.1.24.13.34.2 4025.24033</p>	<p>Ponds Decommissioning</p>	<p>Overview: The scope of the Ponds Decommissioning Project is to remove all of the fuel and contaminated material from the Pond Buildings, to prepare the buildings for demolition followed by demolition of the structures. The baseline strategy for this work is based upon the full decontamination, decommissioning and demolition work of the ponds at Berkeley Power Station. The Ponds Decommissioning project encompasses the following plant areas which will all be remediated using processes similar to those identified below: Washdown Bay and 55 T Crane, Main, Emergency and Standby Fuel Discharge routes, Pond Furniture (including Redundant Furniture), Ponds, Wet & Dry Magnox Vaults and the Dry Skip Store.</p> <p>All tasks associated with Ponds Decommissioning are readily achievable using commercially available and proven technologies and methods. BPM will be applied to all tasks where waste is to be generated and may result in minor modifications to existing technologies to enhance worker protection.</p>						<p>Refs: 10, 19, 25, 31, 32, 50 & 121</p>
<p>3.1</p>	<p>Characterisation</p>		<p>All plant and buildings will be surveyed in preparation for deplanting and demolition in order to identify hazards and manage risk. Hazard management strategies will then be developed for the safe and progressive reduction of hazard, both radiological and conventional, leading to the deplanting and demolition of the redundant facilities. Characterisation will include both invasive and non-invasive techniques. Invasive characterisation will include the collection of core samples from which data on penetration of contaminants can be gained.</p>	<p>9</p>	<p>Assume that no more than 10% of the structures volume will need to be sentenced as LLW</p>	<p>Legislation covering hazardous waste characterisation. Magnox safety rules covering working on plant</p>	<p><i>Suitability of previous sample analysis with respect to alternative wet waste immobilisation techniques (thermal processes)</i></p> <p><i>Characterisation of the following structures required:</i></p> <ul style="list-style-type: none"> <i>Discharge shaft</i> 	<p><i>Ref: 92, 93, 94A, 94B & 105</i></p> <p>Task ID 1.8.1 <i>Lifecycle management of samples</i></p> <p>Task ID 3.1.2</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
					<p><i>All wastes will require a radiochemical analysis to facilitate processing and discharge for the storage location.</i></p> <p>Transport routes to alternative out of country laboratories can be made available to meet HPA sample analysis requirements.</p>	<p><i>Limited resource and laboratory space for radiochemical characterisation.</i></p>	<ul style="list-style-type: none"> • <i>Transit bays</i> • <i>General structures</i> • <i>Detail characterisation of ponds post draining</i> • <i>Magnox vaults</i> • <i>Dry skip store</i> • <i>Pond pump rooms</i> <p><i>The volume of characterisation work may not be deliverable with the existing internal resources and supply chain</i></p>	<p><i>Discharge Shaft characterisation</i> Task ID 3.1.3 <i>Transit bay characterisation</i> Task ID 3.1.4 <i>General pond structures characterisation.</i> Task ID 3.1.5 <i>Ponds post draining detail characterisation.</i> Task ID 3.1.6 <i>Magnox vaults characterisation.</i> Task ID 3.1.7 <i>Dry skip store characterisation.</i> Task ID 3.1.8 <i>Pond pump rooms characterisation</i> Table 3 Task ID 1.8.2 RWDTG scope element N29/08 Radiochemical analysis</p>
<p>3.2</p>	<p>Hazard reduction</p>		<p>Following hazard identification and radiological characterisation, isolations will be applied, radiological, chemical and industrial hazards will be removed to enable subsequent deplanting and demolition of the facilities in accordance with the developed hazard management strategies.</p> <p>Pipework will be flushed and back flushed using installed equipment and plant operating procedures.</p> <p>Surfaces may be washed down or covered in tie down or strippable coatings to reduce loose surface contamination.</p> <p>Contaminated and non-contaminated asbestos will be removed using conventional industry practises, that identified as being potentially contaminated will however need the standard industry practices to be augmented with radiological control procedures and the arisings disposed of as LLW in accordance with the LLW repository requirements.</p> <p>Chemical hazard will also be removed and disposed of using standard industrial techniques adapted to meet the</p>	<p>9</p>	<p>Contaminated asbestos/will be acceptable to the National LLWR once compacted in 200-l drums.</p> <p>Active Effluent Treatment Plant will still be available to handle liquid arisings.</p> <p>Chemicals can be neutralised and processed through the existing active effluent plant.</p>	<p>Legislation and Magnox safety rules covering removal of plant from the system.</p> <p><i>Site discharge authorisation.</i></p> <p><i>Management of Asbestos regulations.</i></p>	<p>Type 2 Asbestos survey for the HPA site.</p> <p>Type 3 Asbestos survey prior to modification / demolition of the Pond buildings</p> <p><i>Applicability and adequacy of generic On Site Disposal solution for HPA.</i></p> <p>Potential opportunity exists to dispose of certain low hazard waste streams on Site as an alternative to</p>	<p>Ref – 95</p> <p>Table 2, Task ID 8.1.3 <i>Asbestos survey</i> Task ID 3.2.4 <i>Asbestos management</i> Task ID 3.2.5 <i>OSD HPA review.</i> Table 3, Task ID 3.2 1 On Site Disposal</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
			specific requirements of the radiological environment. Characterisation of the other contaminated materials will determine the subsequent management strategies and disposal routes.				disposal of LLW to the National LLWR and other hazardous wastes to land fill.	
3.4	Deplanting and decontamination		<p>Radiological characterisation will be undertaken prior to selection and deployment of appropriate cutting and decontamination techniques. Pond furniture will be removed from the pond using tooling and methodologies developed for handling the pond skips. Where contaminated and potentially contaminated materials are being handled cutting processes will be limited to ‘conventional cold cutting techniques’; hydraulic shears, reciprocating saws and metal cutting circular saws, typically bag and cut methods will be used for this to minimise the spread of contamination. Decontamination of steels is likely to be best achieved using abrasive blasting techniques, including hydrolasing, using a variety of media dependent on material and nature of contaminant, as previously successfully used at Berkeley Power Station for ponds and reactor plant decontamination. Where appropriate chemical cleaning processes may also be trialled.</p> <p>To assist in subsequent deplant, demolition and disposal there is also the potential to fix contamination in place to reduce the potential for airborne contamination prior to demolition of the structures or loading into waste containers.</p> <p><i>The Orphan Waste (OW) Project conducted by the Ponds Decommissioning Project at HPA Site (between May 2005 and March 2007) developed improved working arrangements which realised the following benefits:</i></p> <ul style="list-style-type: none"> <i>Increased number of productive worker hours.</i> <i>Improved worker efficiency.</i> <i>Reduction in radiological PPE consumables.</i> <p><i>These lessons will be applied as appropriate within this scope of work</i></p>	9	<p>Only cold cutting techniques will be used for contaminated steel deplanting.</p> <p>Decontaminated materials will be suitable for recycling.</p> <p><i>Waste not viably decontaminable will be sentenced to the appropriate waste packaging and processing plant.</i></p> <p>LLW contaminated material will be sentenced to The National LLWR.</p> <p>Any waste with an ILW content will be transferred to the appropriate ILW project.</p>	Discharge authorisation.	<p><i>Knowledge and understanding of current decontamination techniques and practices for use in decontamination of plant and equipment.</i></p> <p>BPEO for disposal of contaminated metals.</p>	<p>Ref:- 109 & 121</p> <p>Table 2, Task 7.3.1 SPF 9F decontamination trials</p> <p>Table 3, Task ID 3.4.2 RWDTG scope element N34/07 Decontamination Techniques Task 3.4.3 MEL DSO R&D Contaminated and Activated metals</p>
3.5	Clean and drain pond		Decontaminate the pond walls as far as practical using standard high pressure water jet equipment underwater to minimise radiation hazards prior to draining. Drain Ponds and apply fixative to support further decontamination.	7	Following initial underwater decontamination the pond will be drained prior to application of fixative prior to further decontamination.	<p><i>Removal of all materials currently stored in the ponds.</i></p> <p><i>Current discharge authorisations for aqueous and gaseous discharges.</i></p> <p>Pond ventilation system capability.</p>	<p>Alternative approaches to decontaminating and fixing loose contamination on the pond walls during draining to improve worker safety.</p> <p><i>Pond vent system capability to maintain environmental condition appropriate for workforce</i></p>	<p>Table 2, Task ID 3.5.1 Pond decontamination technology</p> <p>Task ID 3.5.2 Vent system analysis and substantiation.</p>
3.8	Export of legacy		<i>That fuel recovered during fuel free verification and desludging activities will be exported to Sellafield in an</i>	9	<i>That the existing fuel despatch routes can be</i>			Table 2

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
	<i>fuel</i>		<i>M2 d/e fuel flask. One flask will be introduced to each pond to facilitate the export of the material via the currently installed despatch route.</i>		<i>recommissioned for a final one off despatch activity</i>	<i>Existing plant configuration</i> <i>Safety case management procedure.</i>	<i>Knowledge of the material condition of the fuel despatch route plant and equipment</i> <i>No safety case available for R2 pond fuel despatch route.</i>	<i>Task ID 3.8.1</i> <i>Plant condition review.</i> <i>Task ID 3.8.2</i> <i>R2 fuel despatch route.</i>
4.0 1.1.1.24.13.32.2 4025.24031 1.1.1.24.13.34.2 4025.24095	Ponds Skips and Miscellaneous Contaminated Items		Overview: The scope of this project includes retrieval and decontamination/processing of approximately 1734 No. spent fuel skips (approx 1200 x 700 x 500mm weighing 105kg each) from site. The total includes those in Reactor 1 Pond (446 No.), Reactor 2 Pond (724 No.) and in the Skip Store (564 No.). 360 No. of the store skips were recovered from the skip store and put into buffer storage within the site Non-combustible Active Waste Store during 2005/06, and the remainder have been retrieved during 2006/07. All but a few of the 564 skip store skips contained rubble. In March of 2006, the National LLWR rescinded its previous agreement with HPA, which originally would have allowed the rubble-filled skips to be disposed of as LLW at the National LLWR site. The project has since emptied every skip (but 23 containing asbestos or other hazardous material), drummed the rubble and characterised the empty skips. This has resulted in an unexpected current population of ~300 ILW skips which will also have to be decontaminated. <i>During the skip store emptying process it was discovered that all of the skips used to store contaminated rubble had had a latex type paint contamination boundary applied. Trials to decontaminate one of these skips identified that the coating behaves differently to the coating on the other skips such that the waste arisings cannot be handled by the installed plant. An alternative method for decontaminating these skips therefore needs to be developed.</i> Decontamination of all ILW skips to LLW will lead to a reduction in the site's higher-hazard waste inventory. The baseline strategy for this work is also based upon the full decontamination, decommissioning and demolition work of the ponds at Berkeley Power Station as referenced above. Removal of the skips from the ponds is <i>a pre-cursor activity to completion of the Fuel Free Verification project.</i>					Ref. 19 & 25
4.3	Retrieval and processing of pond skips.		The skips that are being recovered from Reactor 1 and 2 Ponds will be decontaminated utilising a Robotic Ultra High Pressure Water Jetting (UHPWJ) facility to reduce them from ILW to LLW, they will subsequently be melted for beneficial reuse. The project has converted the old Laundry Building into an Aqueous Decontamination Facility. The project is utilising commercially available products wherever possible in order to reduce design and procurement lead times and reduce the risk exposure from unproven/test products. This approach has been used very successfully for skip export from the skip store where industry standard roller/conveyers have been used to good effect and provide a very simple safe method of skip recovery. Additionally the UHPWJ robotic system used for decontamination is a standard proven product from the automotive industry and has proven incredibly reliable all over the world to date. Debris from the jetting process will be collected in settling tanks prior to the liquid effluent being pumped to the AETP for abatement prior to discharge. <i>The decontaminated skips will be packaged and exported for beneficial reuse by metal melting.</i>	9	UHPWJ will not be able to decontaminate the skips below the free release threshold. <i>UHPWJ will be able to decontaminate ILW skips to LLW.</i> <i>That the LLW skips will be acceptable for processing at the receiving facility.</i> <i>ILW skips may not be recycled and will be disposed of via the Solid ILW MCI and MAC facility.</i>	Discharge authorisations – aqueous, gaseous and solid. Limited space available within the old laundry building for the UHPWJ. Skip store skips have been treated with a coating to limit transfer of contamination	Selection of Best Practicable Means for removal of coating.	<i>Ref:- 109</i> <i>Table 2</i> <i>Task ID 4.3.1</i> <i>Skip store skips decontamination process</i>
6.0 1.1.1.24.13.32.2	Mobile Effluent Treatment Plant		Overview: At present waste water is processed through the pond water treatment plants or the active effluent treatment plant prior to being discharged. As the site progresses through C&M preps arisings requiring processing will reduce and there will be a need to commence decommissioning of the waste water processing plant. In order to release the waste water treatment plants for decontamination and deplanting a temporary mobile effluent plant will be provided to process aqueous arisings.					Ref. 19 & 25

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
4025.24029								
<p>7.0</p> <p>1.1.1.24.13.32.24020. incorporating following dv's</p> <ul style="list-style-type: none"> • 24086 • 24082 • 24094 • 24450 <p>1.1.1.24.13.32.24025. incorporating following dv's</p> <ul style="list-style-type: none"> • 24012 • 24033 • 24050 • 24056 • 24057 • 24087 • 24079 • 24088 • 24095 <p>1.1.1.24.13.32.24035. incorporating following dv's</p> <ul style="list-style-type: none"> • 24051 • 24360 	<p>Radiation Controlled Area (RCA) Deplant and Demolition</p>	<p>Overview: There are a number of facilities within the RCA that will not be required during the C&M phase – these areas will be deplanted and demolished during the C&M Preps phase. The majority of the plant within the floors of the Reactor Building itself will also be deplanted to facilitate the deplanting of the boilers and primary circuit pieces (see Back to Bioshield) although the reactor building itself will be left standing. Conventional deplanting and size reduction techniques will be used to facilitate this whilst working within the existing regulatory framework.</p> <p>Radiological and other hazard characterisation will be undertaken. Isolations will be made in accordance with the Magnox Electric Safety Rules and Guidance from the Ionising Radiations Regulations (IRRs) Code of Practice. Radiological, chemical and industrial hazards will be removed to enable subsequent deplanting and demolition of the facilities.</p> <p>In the reactor building, sections of plant can be isolated as they cease to be required for operational purposes. However, as the opportunities for the use of wholesale isolation techniques to be used in the turbine hall will be less, and with the additional restrictions imposed by radiological conditions, the decommissioning and removal of plant within the ISB will be more involved.</p>		9	<p><i>All wastes will require a radiochemical analysis to prior to processing, storage or disposal.</i></p>	<p><i>Limited resource and laboratory space for radiochemical characterisation.</i></p>	<p>Improve knowledge of potential hazardous wastes found on decommissioning Magnox sites.</p> <p><i>Formal arrangements for:</i></p> <ul style="list-style-type: none"> • <i>lifecycle management of waste samples.</i> • <i>Analysis of samples.</i> • <i>Reporting and management of sample analysis</i> <p><i>The volume of characterisation work may not be deliverable with the existing internal resources and supply chain</i></p>	<p>Ref: 6, 7, 8, 9, 19, 26, 33, 34, 60 & 109</p> <p>Table 3</p> <p>Task 4.4.1</p> <p>MEL DSO R&D Contaminated & Activated Metals.</p> <p>Task 7.0.1</p> <p>MEL DSO R&D Miscellaneous ILW Concrete Project Element Deferred</p>
7.1	Characterisation		<p>All plant and buildings will be surveyed in preparation for deplanting and demolition in order to identify hazards and manage risk. Hazard management strategies will then be developed for the safe and progressive reduction of hazard leading to the deplanting and demolition of the redundant facilities..</p>	9	<p><i>All wastes will require a radiochemical analysis to prior to processing, storage or disposal.</i></p>	<p><i>Limited resource and laboratory space for radiochemical characterisation.</i></p>	<p>Improve knowledge of potential hazardous wastes found on decommissioning Magnox sites.</p> <p><i>Formal arrangements for:</i></p> <ul style="list-style-type: none"> • <i>lifecycle management of waste samples.</i> • <i>Analysis of samples.</i> • <i>Reporting and management of sample analysis</i> <p><i>The volume of characterisation work may not be deliverable with the existing internal resources and supply chain</i></p>	<p>Ref:- 104 & 105</p> <p>Table 2</p> <p>Task ID 1.8.1</p> <p>Lifecycle management of samples</p> <p>Table 3</p> <p>Task ID 1.8.2</p> <p>RWDTG scope element N29/08</p> <p>Radiochemical analysis</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
7.2	Hazardous waste removal		Hazard identification and characterisation will be undertaken, isolations will be applied, radiological, chemical and industrial hazards will be removed to enable subsequent deplanting and demolition of the facilities. Contaminated and non-contaminated asbestos will be removed using conventional industry practises that identified as being potentially contaminated will however need the standard industry practices to be augmented with radiological control procedures and the arisings disposed of as LLW in accordance with the LLW repository requirements. Characterisation of the other contaminated materials will determine the subsequent management strategies and disposal routes.	9	Contaminated asbestos/MMMF will be acceptable to the National LLWR once compacted in 200-l drums.	Legislation and Magnox safety rules covering removal of plant from the system	<p><i>Applicability and adequacy of generic On Site Disposal solution for HPA.</i></p> <p>Potential opportunity exists to dispose of certain low hazard waste streams on site as an alternative to disposal of LLW to The National LLWR and other hazardous wastes to land fill</p>	<p>Table 2, Task ID 3.2.5 OSD HPA review.</p> <p>Table 3 Task 3.2 1 On site disposal</p>
7.3	Radiological deplanting and decontamination		<p>Radiological characterisation will be undertaken prior to selection and deployment of appropriate cutting and decontamination techniques. Where contaminated and potentially contaminated materials are being handle then cutting techniques will be limited to ‘conventional cold cutting techniques’; hydraulic shears, reciprocating saws and metal cutting circular saws. Decontamination of steels is likely to be best achieved using abrasive blasting techniques using a variety of media dependent on material and nature of contaminant, as previously successfully used at Berkeley Power Station for ponds and reactor plant decontamination.</p> <p>To assist in subsequent deplant, demolition and disposal there is also the potential to fix contamination in place to reduce the potential for airborne contamination prior to demolition of the structures or loading into waste containers.</p> <p>When structure deplanted, revealed surfaces will be characterised for clearance purposes, identified areas of contamination will subsequently be targeted in isolation to decontaminate the structure; percussion drills, scabbling heads and concrete planning techniques may all be used, the resulting arisings being fed into the LLW stream. Once adequately decontaminated or contamination demarcation identified conventional demolition will commence.</p> <p><i>The Orphan Waste (OW) Project conducted by the Ponds Decommissioning Project at HPA Site (between May 2005 and March 2007) developed improved working arrangements which realised the following benefits:</i></p> <ul style="list-style-type: none"> • <i>Increased number of productive worker hours.</i> • <i>Improved worker efficiency.</i> • <i>Reduction in radiological PPE consumables.</i> <p><i>These lessons will be applied as appropriate within this scope of work</i></p>	9	<p><i>That closed systems will be flushed prior to deplanting.</i></p> <p>Only cold cutting techniques will be used for contaminated steel deplanting.</p> <p>Decontaminated materials will be suitable for recycling.</p> <p>Metal melting will only be used for recycling of pond skips at this time.</p>	Discharge authorisation.	<p>Use of metal melting to decontaminate and recycle contaminated steels.</p> <p>Use of metal melting to decontaminate and recycle contaminated steels.</p>	<p>Ref: 33, 89 & 109</p> <p>Table 2, Task 7.3.1 SPF 9F decontamination trials</p> <p>Table 3 Task ID 4.4.1 W&D R&D Contaminated and Activated Metals – Project Ref No: 39/39055</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
7.4	Conventional demolition		<p>All structures will be decontaminated, as above, to meet ‘free release criteria’, standard industry techniques will then be utilised wherever possible under the appropriate control & supervision suitable for managing demolition in contaminated and potentially contaminated environments.</p> <p>Where contamination is trapped within the structure or within encast items. Then conventional techniques will be more tightly controlled to ensure contaminated materials can be recovered for processing and suitable disposal. This may require coring of the structure and the use of diamond wire saws to isolate contaminated material for subsequent or sequenced removal during the demolition campaign.</p>	9	Structures will be decontaminated prior to being released for conventional demolition.	Environmental discharge authorisation – free release criteria.		Ref: 33
8.0	<p>Conventional Plant Area Deplant and Demolition</p> <p>1.1.1.24.13.32.2 4030.24036</p> <p>1.1.1.24.13.34.2 4030 Including DV's:</p> <ul style="list-style-type: none"> • 24009 • 24011 • 24068 • 24063 		<p>Overview: After Managed Withdrawal is complete, the areas made redundant, vacated and isolated, they will be available to be decommissioned using conventional demolition means. These facilities will be surveyed and characterised to remove and isolate hazards such as asbestos and electrical supplies. The entire area will be isolated from the ‘system’ and transferred to a selected contractor for deplanting and demolition. Plant and equipment will be removed using standard industry techniques involving both manual and mechanical means as deemed appropriate. Once hazardous materials have been removed from the facility decabbling will commence leading to deplanting of the redundant plant. By controlling and sequencing the deplanting process each waste stream can be segregated for reuse, recycling and off site disposal.</p> <p>The CW Systems will be demolished as part of the conventional plant disposal. The offshore structures are required for operation of the B station and as such will only have the cooling water culverts sealed and grouted with cementitious material. The tunnels and other voids within the site boundary will either be backfilled or left in their current condition dependent on the future hazard they present.</p>					Ref: 8 & 60
8.1	Characterisation		All conventional plant and building will be surveyed in preparation for deplanting and demolition in order to identify hazards and manage risk. Hazard management strategies will then be developed for the safe and progressive reduction of hazard leading to the deplanting and demolition of the redundant facilities..	9	<i>That samples will need to be taken and analysed from conventional plant and buildings for assurance monitoring prior to release off site or for demolition.</i>	Site discharge Authorisation.	<p>Improve knowledge of potential hazardous wastes found on decommissioning Magnox sites</p> <p><i>Formal arrangements for:</i></p> <ul style="list-style-type: none"> • <i>lifecycle management of waste samples.</i> • <i>Analysis of samples.</i> • <i>Reporting and management of sample analysis</i> <p><i>Knowledge of where asbestos is present on the site.</i></p>	<p>Ref:- 104</p> <p>Table 2</p> <p>Task ID 1.8.1 <i>Lifecycle management of samples</i></p> <p>Task ID 8.1.3 <i>Asbestos survey</i></p>
8.2	Removal of the Plant from the System		In order to manage the risks associated with deplanting and demolishing redundant industrial buildings all services supplying or originating from the redundant building will be severed and the building proved dead, when proved complete the building will be taken out the system through the Magnox safety rules exemption	9	This work to be jointly undertaken by Station Staff, directly supported by additional specialist contract labour.	<i>Site E&M and NR safety rules</i>		

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
			process. Once isolated the building will be handed over to contractor for hazard removal, deplanting leading to demolition					
8.3	Hazard remediation		Prior to commencing deplanting the identified hazardous materials will be removed (non contaminated asbestos and Chemicals). Hazard removal will be carried out using industry standard practices, where appropriate licensed contractors will be used for both waste removal and disposal.	9	Hazardous waste will be disposed of at licensed hazardous waste landfill sites.	Installed plant and civil structure. Site discharge authorisation		
8.4	Conventional deplanting		Following hazard remediation the remaining plant will be decabled and then deplanted using conventional tools and techniques. All waste will be segregated to aid recycling of waste materials.	9	Waste will be segregated to maximise recycling of waste. All non hazardous waste will be sentenced for reuse or recycling as appropriate.	Current limitations for reprocessing certain materials		
8.5	Conventional Demolition		Numerous items of plant and buildings outside the RCA require demolition during the C&M Preps phase. Deplant & Demolition of the Turbine Hall will be a major activity within this area. Demolition of the facility will result in a significant 'void' (~30,000m ³) within the turbine hall basement. Within this technical baseline the void will be in-filled with non-hazardous (inert) demolition wastes such as building rubble and soil.	9	Conventional demolition practises will be used throughout the project and voidage backfilled using inert demolition wastes.	Demolition to an agreed brown/green field site condition, and possible engineered waste disposal facility		
9.0	ILW Store	<p>Overview: The ILW Store will provide passive, safe and secure long-term storage for packaged ILW on the HPA Site until such time as the ILW can be exported for final disposal in a National ILW Repository. These wastes are currently awaiting recovery and treatment (as outlined above) and consist of wet debris and sludges resulting from fuel pond operations and solid materials, mainly fuel element debris, resulting from reactor operations.</p> <p>The Store design consists of an above ground reinforced concrete box overlaid with a proprietary steel and aluminium cladding system.</p>						
1.1.1.24.11.12.2 4035.24024								
10.0	Contaminated land	<p>Overview: The nature and extent of radioactive and conventional (chemical/hydrocarbon) contaminated ground (and/or groundwater) varies greatly from site to site (and within sites). HPA will generate sufficient characterisation data for areas of contaminated ground on the site. The management options selection process is referenced in Appendix A of Magnox Electric's Decommissioning & Waste Management Strategy Document ME/S/036 (Ref 5). Its application to contaminated ground will take account of the need for passive safety during (C&M) and the intention to de-license the site at the end of Final Site Clearance.</p> <p>The main strategy options for dealing with contaminated ground include:</p> <ul style="list-style-type: none"> removal of contamination (by excavation); enhanced containment in situ; groundwater control measures; monitoring the contamination in situ without engineered enhancement of containment or groundwater controls. <p>Different strategic options might be pursued for different zones of contamination on the site. For each of these strategic options, there are a number of potential technical approaches, but the technical baseline is to use existing mature technology (TRL 9).</p> <p>For options in which some radioactive contamination remains in situ during C&M and does not decay to below regulatory concern prior to Final Site Clearance, the technical baseline assumes that residual contamination will be removed by excavation for off-site disposal during Final Site Clearance.</p> <p>The main non-radioactive contamination issue at HPA is contamination by hydrocarbons, for which the technical baseline is to remove free hydrocarbon product from the ground (so far as is reasonably practicable) then deal with the remaining contamination of soils and groundwater principally by monitored natural attenuation. The technical baseline for dealing with non-radioactive contamination is to use existing mature technology (TRL 9).</p>						Ref: 5, 19, 22, 58, 63, 64, 65 & 119

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
<p>10.1</p> <p>1.1.1.24.13.36.2 4040.24015</p>	<p>Site characterisation</p>		<p>To develop management strategies for managing contaminated ground, site characterisation is ongoing. A desk-top review of historical information regarding spills and leaks to identify potential areas of contamination has been completed and findings have been included in the Site's Characterisation Gap Analysis Report.. An iterative characterisation strategy has subsequently been developed:</p> <ul style="list-style-type: none"> • Non-intrusive characterisation using surface radiological surveys • Intrusive surveys using boreholes and/or sampling pits to obtain data on identified areas of contamination, to assess the extent of any spread of the contamination and to create a hydro-geological conceptual model of the site to predict future spread of contamination. • Time-series monitoring of groundwater levels and quality. <p>The results of the characterisation works have been and will be presented in a series of factual and interpretative reports.</p> <p>Strategy development (as required by ME/S/154) will take account of the characterisation results.</p>	<p>9</p>	<p><i>Samples will require radiochemical characterisation.</i></p>	<p>Physical layout of the site currently constrains the locations of bore holes and pits.</p> <p>The concentration of buildings within the RCA also constrains the surface radiological surveys.</p> <p><i>Limited resource and laboratory space for radiochemical characterisation..</i></p>	<p>Characterisation of ground contamination at HPA is not yet complete.</p> <p>The monitoring is ongoing, potentially continuing into care and maintenance and until such time as discontinuing monitoring can be justified.</p> <p>Understanding of hydrocarbon contamination remediation issues.</p> <p><i>Knowledge of ground conditions beneath existing building foundations.</i></p> <p><i>Management plan for areas of contaminated land and areas still to be characterised.</i></p> <p><i>The volume of characterisation work may not be deliverable with the existing internal resources and supply chain.</i></p>	<p>Ref: 63, 64, 65 & 119</p> <p>Table 2, Task ID 10.1.1 Site Contaminated Land Characterisation Survey.</p> <p><i>Task 1.8.1 Lifecycle management of samples.</i></p> <p><i>Task ID 10.1.3 Under Building Sampling and Characterisation.</i></p> <p><i>Task ID 10.1.4 Land Quality Management Plan.</i></p> <p>Table 3 <i>Task 1.8.2 RWDTG scope element N29/08 Radiochemical analysis</i></p>
<p>11.0</p>	<p>Back to Bio-shield</p>		<p>Overview: Asbestos removal will have been completed in the boiler blower houses prior to commencing deplanting of the primary gas ducts, boiler and associated plant and equipment The upper and lower gas ducts will be isolated at the gas valves and all external duct component removed and laid down, the boilers will then also be removed and laid down. Blower halls and boiler houses will have been deplanted as described above to facilitate removal of boilers and gas ducts and the final demolition of the boiler blower houses.</p>					
<p>12.0</p>	<p>Safe Store Preparations</p>		<p>Overview: The current Lifetime Plan strategy is to create a "Reactor Safestore" that would safely contain an amount of plant and equipment within the existing Reactor building for a period of up to 100 years.</p> <p>The building will be clad in weatherproof sheeting. The end state of the site for C&M Preps is one of much reduced visual impact that will be safe & robust to remain in a quiescent state for the period of C&M.</p>					
<p>13.0</p>	<p>Care & Maintenance</p>		<p>Overview: The end state of the site following completion of the C&M Preps phase will comprise of the reactor buildings reduced to the limit of the bioshield and clad for safestore and the ILW store together with any services required to maintain the site through the C&M period. All other buildings will have been demolished to ground level; voids filled and made safe, and the site partially landscaped to ensure that no hazards, e.g. water hazards, may collect over time.</p> <p>The remaining hazards on the site, the reactors, primary gas circuit components and ILW store will be in a safe, secure, fully contained, protected and robust condition for the duration of C&M to allow radioactivity to decay to lower levels prior to FSC. Packaged ILW will be removed from site to a National ILWR when it becomes available.</p>					

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
14.0	Final Site Clearance	Overview: At the end of the FSC period all of the hazardous and radioactive material, above agreed limits, including that below ground level, will have been removed from the site and all structures removed to at least ground level with any below ground level voids back-filled where necessary for safety reasons. Finally, the Site will be subjected to extensive radioactivity surveys to confirm that no unacceptable radioactivity remains on or below the site and that the site can be delicensed.						
15.0	Site End State	Overview: The end point of FSC period is assumed to be a delicensed site with all structures removed to at least ground level, landscaped and planted with appropriate locally indigenous flora thus allowing the site to be made available for any alternative appropriate use. Ground level voids will be backfilled where necessary for safety reasons. Any remaining significant areas of contaminated land will be removed. The entire site within the outer fence will be regraded and covered with imported topsoil. The site will be subjected to detailed and extensive radioactivity surveys to confirm no unacceptable radioactivity remains. Once confirmed, the Nuclear Site Licence requirement can be removed and the site will no longer be subject to the requirements of an RSA93 Authorisation.						

Table 1A: Hinkley Point A - Technical Baseline (Work that is on-hold for FY 2008-09)

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
1.0 1.1.1.24.11.12.2 4035.24021 1.1.1.24.13.34.2 4025.24056	Wet ILW - Retrieval & Processing							<p>Refs: 2, 3, 13, 14, 15, 16, 19, 21, 25, 28, 29 & 30</p> <p>MEL W&D R&D Wet ILW</p>
1.3 1.1.1.24.11.12.2 4025.24008	Drier desiccant		The drier desiccant material will be recovered from the gas driers into temporary containers prior to transfer into a 3m3 liner in Transportable Intermediate Level Waste Solidification Plant ~-(TILWSP)for immobilisation using a Pulverised Fly Ash (PFA) / Ordinary Portland Cement (OPC) grout mix. Solidified waste form will be loaded into stillages for storage in the ILW store.	5	<p>Drier desiccant will be encapsulated in a cementitious grout using TILWSP prior to interim storage in the site ILW store.</p> <p>That a revised environmental discharge authorisation will not be required for encapsulation of the drier desiccant.</p> <p>That the drier desiccant is ILW.</p> <p><i>That Desiccant is currently an "Orphan" waste stream.</i></p>	<p>Encapsulation of drier desiccant in a cementitious grout increases tritium evolution as a result of the exothermic reaction created by the cement curing reaction.</p> <p>Regulators do not consider unencapsulated materials to be passively safe.</p> <p>Site tritium discharge authorisation</p> <p><i>Deferring decommissioning activities requires more staff to become familiar with the concept and processes for immobilising desiccant wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future.</i></p> <p>A disposal method and route is required for all waste.</p>	<p>Produce BPEO for gas drier desiccant.</p> <p>Characterisation of the drier desiccant.</p> <p>Volume of Tritium released to the environment as a result of the encapsulation process.</p> <p><i>Potential to create a sealed inner container using grout.</i></p> <p><i>Knowledge management – capture of current knowledge and understanding regarding process and immobilisation requirements for the future.</i></p> <p>There is currently no agreed disposal method or route for desiccant wastes.</p>	<p>Ref. 66 & 84</p> <p>Table 2,</p> <p>Task 1.3.1 Gas drier desiccant packaging solution</p> <p>Task 1.3.2 Gas drier desiccant characterisation</p> <p>Task 1.3.3 Tritium discharge resulting from encapsulation.</p> <p><i>Table 3,</i></p> <p><i>Task 1.3.4</i> <i>Grout enclosure techniques.</i></p> <p><i>Task ID 1.3.5</i> <i>RWDTG scope element N32/07 Handbook for the processing and immobilisation of desiccant waste.</i></p> <p>Task 7.0.1</p> <p>MEL DSO R&D Miscellaneous ILW Desiccant element Project ref No: 39/39053.</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
1.6	Package Despatch & Cross Site Transport		<p>The package despatch facility will interface with the Cross Site Transporter and provide the replicable features of both the ILW Store import bay and the Solid ILW export facilities, such that the transporter can dock and interface with the facility.</p> <p>The cross site transporter is based on a commercially available multi-wheel vehicle adapted to carry a shielded overpack.</p>	6	<p>SILWR will provide the cross site transporter to meet the process requirements of the Wet ILW project.</p> <p>That cross site transporter will have sufficient space to access the despatch facility.</p>	<p>The docking arrangement for the cross site transporter has been designed by the ILW store project – all other ILW producing facilities will need to replicate the features.</p>	<p>See SILWR for Cross Site Transporter.</p>	<p>See Table 2 Section 2.5 for cross site transporter.</p>
2.0 1.1.1.24.11.12.2 4035.24020 1.1.1.24.13.34.2 4035.24057	Solid ILW - Retrieval & Processing	<p>Overview: During the operational lifetime of HPA Power Station, intermediate level waste accumulated in the vaults of R1 and R2 Pond Complexes, and in the NCAW basement. The Solid ILW Project consists of the design, procurement, construction, operation, commissioning and ultimate decommissioning of the necessary plant/equipment to retrieve, process and ultimately encapsulate the above material prior to its transfer to the sites ILW Store.</p> <p>The Solid ILW project deals with the removal of fuel element debris (FED) from the R1 and R2 Pond Complex vaults and other miscellaneous materials (MCI & MAC) currently stored in the NCAW basement, to storage in the new ILW store. The quantities to be retrieved, processed and stored are: 775m³ (FED); 484,000 (~1m³) Activated Nimonic Springs; 20m³ Gravel; and a quantity of MCI & MAC, all as defined within the projects Feedstock Data Report [90]</p>						<p>Ref: 11, 17, 19, 20, 25, & 90</p>
2.1	Fire detection and suppression system		<p>It is intended that a system be installed to provide protection from a fire initiating in either of the dry Magnox vaults. An optioneering study is required to select the most appropriate technology several potential solutions are available including; fire detection and argon suppression (installed at both Berkeley and Trawsfynydd) and Fire prevention currently being developed for use at Hunterston.</p>	6	<p>It has been assumed that an engineered safeguard will need to be provided to mitigate a fire in the Magnox vault.</p> <p>That the fire model developed to assess the spread of fires in Magnox vaults accurately replicates conditions within the HPA vaults.</p>	<p>There are a variety of constraints based around the requirement for shielding and containment both of which will differ dependent on the chosen solution.</p> <p>It is assumed that in all fault scenarios where a fire is initiated that the structure of the vault remains intact.</p>	<p>R&D will be required to model the dispersion and diffusion of gases within the waste retrieval facility, Magnox vault and waste pile. Dependent on the fire protection system selected further specific R&D will then be necessary</p>	<p>Ref 36 & 117</p> <p>Table 2, Task ID 2.1.1 Vault fire system modelling</p>
2.5	Cross Site Transporter		<p>The cross site transporter is based on a commercially available multi-wheel vehicle adapted to carry a shielded overpack.</p>	6	<p>It is assumed that the cross site transporter can be controlled to repeatedly and accurately position the overpack beneath each waste facilities docking snout.</p>	<p>The sites physical layout is very constraining which has driven the requirement to select an extremely manoeuvrable bogie unit.</p>	<p>Trials are required to prove that the control system ‘line following’ technology has the ability to repeatedly and accurately follow the marker system and park itself within the necessary tolerance range of the package handling cranes.</p>	<p>Table 2, Task ID 2.5.1 Cross site transporter control system and alignment trials.</p>
2.6	Waste Boxes		<p>Waste boxes will be RWMD compliant and based on current designs, being of stainless steel fabricated construction with lifting features to mate with a twist lock grapple and a waste loading aperture in the upper surface with a bolt on lid.</p>	6	<p>Box modifications being developed for Berkeley and HPA will not invalidate existing RWMD conformance tests.</p> <p>UngROUTED waste boxes will be lifted around the process</p>	<p>Existing 3m³ box and lifting feature design.</p>	<p>Anti-floatation mesh design may need further development dependent on the geometry of the box lidding station.</p> <p>Trials will need to be carried out using stiffened boxes to</p>	<p>Ref:- 97</p> <p>Table 2, Task ID 2.6.1 RWMD box base</p>

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					<p>plant.</p> <p>Bleed water will need to be removed from the grouted box to enable prompt application of ‘capping’ grout.</p>	<p>RWMD requirements for package integrity and cleanliness.</p>	<p>confirm waste loading and box base deflection values.</p> <p>Investigate appropriate means of maintaining the waste box containment boundary prior to encapsulation – particularly blanking of the grout ports.</p> <p>Selection of box material for extended storage.</p> <p>Supply strategy for waste boxes across the fleet</p> <p>Guidance on storage and inspection of waste boxes during interim storage</p>	<p>stiffening.</p> <p>Table 3,</p> <p>Task ID 2.6.3 RWDTG scope element S19/07 Package material selection.</p> <p>Task ID 2.6.4 RWDTG scope element S03/08 Magnox Storage Guidance</p>
<p>3.0</p> <p>1.1.1.24.13.34.2 4025.24033</p>	<p>Ponds Decommissioning</p>	<p>Overview: The scope of the Ponds Decommissioning Project is to remove all of the fuel and contaminated material from the Pond Buildings, to prepare the buildings for demolition followed by demolition of the structures. The baseline strategy for this work is based upon the full decontamination, decommissioning and demolition work of the ponds at Berkeley Power Station. The Ponds Decommissioning project encompasses the following plant areas which will all be remediated using processes similar to those identified below: Washdown Bay and 55 T Crane, Main, Emergency and Standby Fuel Discharge routes, Pond Furniture (including Redundant Furniture), Ponds, Wet & Dry Magnox Vaults and the Dry Skip Store.</p> <p>All tasks associated with Ponds Decommissioning are readily achievable using commercially available and proven technologies and methods. BPM will be applied to all tasks where waste is to be generated and may result in minor modifications to existing technologies to enhance worker protection.</p>						<p>Refs: 10, 19, 25, 31, 32, 50 & 121</p>
<p>3.3</p> <p>1.1.1.24.13.32.2 4025.24008</p>	<p>Ionsiv cartridges</p>		<p>IONSIV cartridges are from the Submersible Caesium Removal Unit (SCRU) and are currently stored in Skips in the Cooling Ponds. These are categorised as ILW and will be placed in DCI drums in the Flask Passage using remote means, where they will be encapsulated. This work will be done remotely to limit operator dose.</p>	<p>3</p>	<p>Will be dealt with in line with company policy now being developed. The polymer encapsulation technology has been proven and advice has been received on the ILoC submission.</p> <p><i>That non intrusive Ionsiv cartridge characterisation can be satisfactorily demonstrated through non intrusive means.</i></p>	<p><i>Handling capability for loading DCI drum into pond.</i></p> <p><i>Ionsiv cartridges will need to have been removed from the pond prior to cleaning and draining.</i></p> <p><i>A disposal method and route is required for all waste.</i></p> <p>Physical movement of the IONSIV cartridges from the ponds into the DCI drums for polymer encapsulation.</p>	<p>Characterisation of the Ionsiv cartridges</p> <p><i>Potential alternative solutions for immobilisation of Ionsiv resin material.</i></p> <p>A trial plant needs to be built to demonstrate the methodology required for this waste.</p> <p><i>Handling solution for the DCI drums within the existing ponds structures.</i></p>	<p>Ref: 54, 67 & 91</p> <p>Table 2</p> <p><i>Task ID 3.3.1 Ionsiv characterisation</i></p> <p><i>Task ID 3.3.2 Alternative Ionsiv packaging technologies</i></p> <p><i>Task ID 3.3.3 Ionsiv formulation trials.</i></p> <p><i>Task ID 3.3.4 DCI drum design optimisation.</i></p> <p>Table 3,</p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
							<i>IX resin knowledge management</i>	<p>Task ID 1.5.10 Handbook of the processing and immobilisation of organic IX resin wastes</p> <p>Task 7.0.1 <i>MEL DSO R&D Miscellaneous ILW Ionsiv</i> Project ref No: 39/39057.</p>
3.6	Structural decontamination		<p>Once structure deplanted, or pond drained, revealed surfaces will be characterised for clearance purposes, identified areas of contamination will subsequently be targeted in isolation to decontaminate the structure; percussion drills, scabbling heads and concrete planning techniques may all be used, the resulting arisings being fed into the LLW stream either for encapsulation as a mobile waste stream or as backfill material in a half height ISO container.</p> <p>Decontamination of the pond structure will require further detailed characterisation to confirm depth of contamination and determine if decontamination to free release is possible, practical and cost effective. If free release is practical, pilot demonstration study will be commissioned to establish methods and cost.</p> <p>Where contamination is trapped within the structure or within encast items and can only be removed during demolition, care will be taken to identify and isolate the contaminated material prior to commencing demolition. This may involve sealing encast items with polyurethane expanding foam, attaching bungs or welding covers on.</p>	8	<p>Structures will be decontaminated prior to being released for conventional demolition.</p> <p>It is assumed that the pond structure can be decontaminated to permit conventional demolition techniques to be used, however once detailed understanding of level of pond structure contamination gained a BPM study will be prepared.</p>	<p>Environmental discharge authorisation – free release [below levels of regulatory interest] criteria.</p> <p>Depth and spread of contamination within pond structure requires detailed characterisation prior to confirming technical solution for its demolition.</p> <p>Contaminated encast items.</p>	<p><i>Characterisation of the following structures required:</i></p> <ul style="list-style-type: none"> • <i>Discharge shaft</i> • <i>Transit bays</i> • <i>General structures</i> • <i>Detail characterisation of ponds post draining</i> • <i>Magnox vaults</i> • <i>Dry skip store</i> • <i>Pond pump rooms</i> <p><i>Arrangements for demolishing contaminated and potentially contaminated structures.</i></p>	<p>Ref: 33 & 92</p> <p>Table 2,</p> <p>Task ID 3.1.2 <i>Discharge Shaft characterisation</i></p> <p>Task ID 3.1.3 <i>Transit Bay characterisation</i></p> <p>Task ID 3.1.4 <i>General pond structures characterisation.</i></p> <p>Task ID 3.1.5 <i>Ponds post draining detail characterisation.</i></p> <p>Task ID 3.1.6 <i>Magnox vaults characterisation.</i></p> <p>Task ID 3.1.7 <i>Dry skip store characterisation.</i></p> <p>Task ID 3.1.8 <i>Pond pump rooms characterisation.</i></p> <p>Task ID 3.7.1 <i>Contaminated structure demolition.</i></p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
3.7	Demolition		<p>Once adequately decontaminated or contamination demarcation identified conventional demolition will commence. Standard industry techniques will then be utilised wherever possible under the appropriate control & supervision suitable for managing demolition in contaminated and potentially contaminated environments.</p> <p>Where contamination is trapped within the structure or within encast items. Then conventional techniques will be more tightly controlled to ensure contaminated materials can be recovered for processing and suitable disposal. This may require coring of the structure and the use of diamond wire saws to isolate contaminated material for subsequent or sequenced removal during the demolition campaign.</p>	9	<i>That building will be demolished when radiologically clean</i>	<i>Decontamination of structures to the point where they present no further hazard</i>	<i>Arrangements for demolishing structures where it has not been possible to confirm removal of radiological hazard or wher hazard remains trapped by the structure until it can be demolished.</i>	<p>Ref: 32, 33 & 34</p> <p>Table 2</p> <p><i>Task ID 3.7.1 Contaminated structure Demolition</i></p>
4.0 1.1.1.24.13.32.2 4025.24031 1.1.1.24.13.34.2 4025.24095	Ponds Skips and Miscellaneous Contaminated Items		<p>Overview: The scope of this project includes retrieval and decontamination/processing of approximately 1734 No. spent fuel skips (approx 1200 x 700 x 500mm weighing 105kg each) from site. The total includes those in Reactor 1 Pond (446 No.), Reactor 2 Pond (724 No.) and in the Skip Store (564 No.). 360 No. of the store skips were recovered from the skip store and put into buffer storage within the site Non-combustible Active Waste Store during 2005/06, and the remainder have been retrieved during 2006/07. All but a few of the 564 skip store skips contained rubble. In March of 2006, the National LLWR rescinded its previous agreement with HPA, which originally would have allowed the rubble-filled skips to be disposed of as LLW at the National LLWR site. The project has since emptied every skip (but 23 containing asbestos or other hazardous material), drummed the rubble and characterised the empty skips. This has resulted in an unexpected current population of ~300 ILW skips which will also have to be decontaminated. <i>During the skip store emptying process it was discovered that all of the skips used to store contaminated rubble had had a latex type paint contamination boundary applied. Trials to decontaminate one of these skips identified that the coating behaves differently to the coating on the other skips such that the waste arisings cannot be handled by the installed plant. An alternative method for decontaminating these skips therefore needs to be developed.</i></p> <p>Decontamination of all ILW skips to LLW will lead to a reduction in the site's higher-hazard waste inventory. The baseline strategy for this work is also based upon the full decontamination, decommissioning and demolition work of the ponds at Berkeley Power Station as referenced above.</p> <p>Removal of the skips from the ponds is <i>a pre-cursor activity to completion of the Fuel Free Verification project.</i></p>					Ref. 19 & 25
6.0 1.1.1.24.13.32.2 4025.24071	Mobile Effluent Treatment Plant		<p>Overview: At present waste water is processed through the pond water treatment plants or the active effluent treatment plant prior to being discharged. As the site progresses through C&M preps arisings requiring processing will reduce and there will be a need to commence decommissioning of the waste water processing plant. In order to release the waste water treatment plants for decontamination and deplanting a temporary mobile effluent plant will be provided to process aqueous arisings.</p>					
6.1	Mobile effluent treatment		<p>Waste water arisings have been projected through to the end of the C&M preparations phase of site decommissioning. In order to release the existing Pond Water and Active Effluent Treatment Plants for decommissioning it will be necessary to provide a temporary Mobile Effluent Treatment Plant (METP) to manage the end of C&M preps aqueous arisings. It is intended that this plant will comprise skip mounted pumps, cartridge type particulate filters and activity abatement filters. Temporary holding tanks for arisings will be double contained. Discharge from the plant will be via the existing effluent discharge line. Temporary hose connections will interface with the donor plant facilities.</p>	9	<p>METP will discharge down the existing active effluent discharge line.</p> <p>The METP will not be required until after the cooling ponds have been dewatered.</p> <p>That a revision to the aqueous discharge authorisation will be required prior to putting the METP into service.</p> <p>All METP will be constructed using robust,</p>	<p>The METP needs to be appropriately sized to process the projected arisings.</p> <p>Site physical space constraints and the requirement to tie into the existing active effluent discharge line.</p>	<p>The optimal point at which treatment of the waste water arising transfers to the METP needs to be identified in order to define the performance requirements of an METP.</p> <p><i>Assess PWTP & AETP capability against projected</i></p>	<p>Ref. 19, 25, 85 & 116</p> <p>Table 2,</p> <p><i>Task ID 6.1.3 PWTP & AETP decommissioning strategy.</i></p> <p><i>Task ID 6.1.4 PWTP & AETP</i></p>

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
					readily available components taken from manufacturer's standard catalogue.		<i>arisings</i>	<i>capability assessment</i>
<p>7.0</p> <p>1.1.1.24.13.32.24020. incorporating following dv's</p> <ul style="list-style-type: none"> • 24086 • 24082 • 24094 • 24450 <p>1.1.1.24.13.32.24025. incorporating following dv's</p> <ul style="list-style-type: none"> • 24012 • 24033 • 24050 • 24056 • 24057 • 24087 • 24079 • 24088 • 24095 <p>1.1.1.24.13.32.24035.24051</p>	<p>Radiation Controlled Area (RCA) Deplant and Demolition</p>		<p>Overview: There are a number of facilities within the RCA that will not be required during the C&M phase – these areas will be deplanted and demolished during the C&M Preps phase. The majority of the plant within the floors of the Reactor Building itself will also be deplanted to facilitate the deplanting of the boilers and primary circuit pieces (see Back to Bioshield) although the reactor building itself will be left standing. Conventional deplanting and size reduction techniques will be used to facilitate this whilst working within the existing regulatory framework.</p> <p>Radiological and other hazard characterisation will be undertaken. Isolations will be made in accordance with the Magnox Electric Safety Rules and Guidance from the Ionising Radiations Regulations (IRRs) Code of Practice. Radiological, chemical and industrial hazards will be removed to enable subsequent deplanting and demolition of the facilities.</p> <p>In the reactor building, sections of plant can be isolated as they cease to be required for operational purposes. However, as the opportunities for the use of wholesale isolation techniques to be used in the turbine hall will be less, and with the additional restrictions imposed by radiological conditions, the decommissioning and removal of plant within the ISB will be more involved.</p>				<p>Ref: 6, 7, 8, 9, 19, 26, 33, 34, 60 & 109</p> <p>Table 3</p> <p>Task 4.4.1</p> <p>MEL DSO R&D Contaminated & Activated Metals.</p> <p>Task 7.0.1</p> <p>MEL DSO R&D Miscellaneous ILW Concrete Project Element Deferred</p>	
<p>8.0</p> <p>1.1.1.24.13.32.24030. Including DV's:</p> <ul style="list-style-type: none"> • 24036 • 24037 • 24038 • 24039 • 24043 <p>1.1.1.24.13.34.24030 Including DV's:</p> <ul style="list-style-type: none"> • 24009 • 24014 • 24068 • 24063 • 24074 	<p>Conventional Plant Area Deplant and Demolition</p>		<p>Overview: After Managed Withdrawal is complete, the areas made redundant, vacated and isolated, they will be available to be decommissioned using conventional demolition means. These facilities will be surveyed and characterised to remove and isolate hazards such as asbestos and electrical supplies. The entire area will be isolated from the 'system' and transferred to a selected contractor for deplanting and demolition. Plant and equipment will be removed using standard industry techniques involving both manual and mechanical means as deemed appropriate. Once hazardous materials have been removed from the facility decabbling will commence leading to deplanting of the redundant plant. By controlling and sequencing the deplanting process each waste stream can be segregated for reuse, recycling and off site disposal.</p> <p>The CW Systems will be demolished as part of the conventional plant disposal. The offshore structures are required for operation of the B station and as such will only have the cooling water culverts sealed and grouted with cementitious material. The tunnels and other voids within the site boundary will either be backfilled or left in their current condition dependent on the future hazard they present.</p>				<p>Ref: 8 & 60</p>	

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
9.0 1.1.1.24.11.12.2 4035.24024	ILW Store		Overview: The ILW Store will provide passive, safe and secure long-term storage for packaged ILW on the HPA Site until such time as the ILW can be exported for final disposal in a National ILWR. These wastes are currently awaiting recovery and treatment (as outlined above) and consist of wet debris and sludges resulting from fuel pond operations and solid materials, mainly fuel element debris, resulting from reactor operations. The Store design consists of an above ground reinforced concrete box overlaid with a proprietary steel and aluminium cladding system.					Ref: 25, 51, 52, 53, 59
9.1	Package import		The overpack transporter docks with a port in the receipt bay. The overpacks shield gate is opened by the store control room. The package handling machine removes the shield plug from the docking port and then collects the waste package and loads it into the storage vault, the package handling machine then reinstalls the store shield plug. The overpack shield gate is closed and the transporter can be undocked.	9	That shielding is provided by the docking port at the interface with the overpack and no additional shielding is required. Workforce will be excluded from the import bay by a roller shutter door during import/export activities interlocked to the operation of the package handling machine for shield plug removal. <i>That HPA ILW will be conditioned and stored at HPA.</i> That no ILW originating from other sites will be received at HPA for conditioning and storage	Docking port geometry to provide adequate shielding to workers at the roller shutter door extremity. Road transport containers are not currently readily available for the movement of ILW between Magnox sites	<i>ILW may be exported for conditioning at other sites ILW may be received from other sites for conditioning and storage.</i>	Table 3 Task ID 1.5.9 DSF – ILW Transportation
9.2	Package inspection facility		The package inspection facility is provided with a stand, reconfigurable robot arm and a camera system.	6	That all waste packages will be delivered to the ILW store in nominally clean condition (below 4Bq/g βγ and 0.4Bq α.) It will therefore not be necessary to swab packages for acceptance into the ILW store. Access to the cell will not be restricted when waste packages are not present	The civil structure of the inspection cell and the encast penetrations for provision of future services to the inspection cell.	Pre-storage package inspection requirements still require definition.	Ref:- 97 R&D being progressed in sections 9.5, 9.6 and 9.7 required in order to develop inspection requirements
9.3	Package handling machine		The Package Handling Machine (PHM) is an electric overhead gantry crane fitted with a four point twist lock grapple to interface with the RWMD packages and any other item of equipment fitted with similar features. The PHM runs on long travel rails designed to last the life of the store, supplies and control signals are fed to the crane down a pair of cable reeling drums. The cables are fitted with strain wires to allow the reeling system to be used for long travel recovery. Recovery drives are fitted to the cross travel, hoist system and grapple box and are fed separately to the service drives where possible.	9	Waste package design for grapple box interface. The PHM is only designed for recovery against single fault scenarios. The package handling machine does not need to be design for decontaminability.	Radiological constraints from handling active waste packages		Ref: 53

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
9.4	Service facilities		The Service Area incorporates the receipt facilities, control suite and PHM maintenance facilities. The PHM maintenance facility is protected from the waste in the vault by a labyrinth system and vertical rising shield door. The vertical rising shield door is hydraulically powered and is driven upwards to close. The maintenance facility is fitted with necessary staging and equipment to facilitate foreseeable maintenance and statutory inspection requirements	9	That the crane structure will not need to be replaced during the operational life of the store. The service facilities will be provided with good quality surface finishes and where appropriate load pads. Strippable coatings and decontaminable surfaces will not be applied.	Long travel rails can only be remotely maintained during the life of the vault.		
9.5	Storage vault		The Store is designed to hold 1110 RWMD standard packages (3m3 boxes or 3m3 drums). The overall dimensions of the store are 78m long x 24m wide x 18m high based on a standard civil design and incorporating standard construction techniques. 500-l drums	8	Seismic justification of the structure is not required. Space for 1110 packages is adequate to store the sites known ILW arisings. The storage of dummy waste packages for corrosion monitoring purposes will not compromise the stores ability to receive operational ILW. 500-l drums and there associated stillages will not be used to solidify HPA waste streams. <i>ILW packages will be recovered from the storage vault for through life inspection.</i>	The size of the vault. (Size was based on a statistical analysis of waste package numbers) <i>Maintenance of an optimal package storage environment to minimise package degradation.</i>	Knowledge of environmental conditions, corrosion rates and gas release rates. <i>Care and Maintenance safety cases are not approved owing to the absence of a company standard for waste package monitoring specification</i> <i>Aging processes for waste in storage.</i> <i>Knowledge of metal-grout de-bonding mechanism</i>	Ref. 69, 99 Table 3, Task ID 9.5.1 RWDTG scope element S06/07 Position statement on design and operational concepts for Magnox ILW stores. Task ID 9.5.3 RWDTG scope element N33/08 <i>Reworking and Package longevity</i> Task ID 9.5.4 RWDTG scope element N35/08 <i>Fault condition storage and movement</i>
9.6	Atmospheric control		The store needs to be able to manage the atmosphere within it to satisfy two key objectives; <ul style="list-style-type: none"> • Maintain hydrogen levels within the vault below 25% of the Lower Explosion Limit. • Control the moisture content of atmosphere to minimise chloride ingress and package corrosion. Atmospheric control will be provided by permanently installed ducting in the vault designed for the operational life of the Store and an external ventilation system within the weather envelope designed to recirculate the vaults air extracting from below the vault soffit and returning air below the corbel blowing it vertically downwards. The vent system will replace a proportion of the handled air mass, conditioning the replacement fraction while expelling a similar fraction back to the environment.	7	That the vent system will be able to control the vault environment with the constraints identified in the RWMD package ACOP. That the vent system will not be required in service continually throughout the package storage phase.	Any equipment required in the vault during the storage phase will need to be installed during construction or be able to be handled using the package handling machine grapple.	Research of gas generation rates with respect to store environment from encapsulated cementitious waste forms.	Ref. 18, 68 & 99 Table 3, Task ID 9.6.1 RWDTG scope element N12/07 Application of MAGGAS model to cemented wastes.

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
			It is expected that the vent system will need to operate throughout the filling phase in order to manage the hydrogen evolving from the encapsulation process. During the storage period the vent system will be available to manage the vault atmosphere as required to maintain appropriate package storage conditions.					
9.7	Package periodic inspection		Throughout the package storage period it will be necessary to recover and inspect waste packages to assess degradation of the waste package. This will be achieved using the package handling machine and the Inspection Facility.	7	To minimise potential for damage to active packages dummy waste packages will be installed in the vault for monitoring and inspection requirements.	ILW store installed plant and equipment. Provision of encast items for future use within the package inspection cell.	Strategy for the deployment of dummy waste packages to underpin long term storage safety case. Understanding of corrosion issues arising from there disturbance during storage prior to export to the RWMD repository Lifetime modelling of package corrosion covering package movement and inspection requirements.	Ref:- 97, 99 & 100 Table 3 Task ID 9.7.2 DSF – RWDTG scope element 11/07 Long term monitoring of cemented waste. Task ID 9.7.3 DSF – RWDTG scope element 18/07 Effect of package movement. Task ID 9.7.4 DSF – RWDTG scope element 13/07 Corrosion assessment of containers of cemented waste.
9.8	Package export		Pending availability of a national repository to accept the waste it is currently assumed within this Lifetime Plan to commence retrieval of the packages in 2048, the overall process taking two years. It is a condition of the current planning consent that the building be demolished and removed within 3 years, or such longer period as may be agreed in writing, of a national facility for the long term management of Intermediate Level Waste becoming available.	7	Waste will be exported to RWMD repository between 2046 & 2048. The RWMD package transporter will be capable of interfacing with the package import docking station. Following completion of the store filling phase the cross site transporter will be disposed of as potentially contaminated plant and equipment.	The ILW Store import facility and docking port.	Concept design for export and transportation of RWMD waste packages	Ref:- 97
10.0	Contaminated land	<p>Overview: The nature and extent of radioactive and conventional (chemical/hydrocarbon) contaminated ground (and/or groundwater) varies greatly from site to site (and within sites). HPA will generate sufficient characterisation data for areas of contaminated ground on the site. The management options selection process is referenced in Appendix A of Magnox Electric’s Decommissioning & Waste Management Strategy Document ME/S/036 (Ref 5). Its application to contaminated ground will take account of the need for passive safety during (C&M) and the intention to de-license the site at the end of Final Site Clearance.</p> <p>The main strategy options for dealing with contaminated ground include:</p> <ul style="list-style-type: none"> removal of contamination (by excavation); 						Ref: 5, 19, 22, 58, 63, 64, 65 & 119

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
			<ul style="list-style-type: none"> enhanced containment in situ; groundwater control measures; monitoring the contamination in situ without engineered enhancement of containment or groundwater controls. <p>Different strategic options might be pursued for different zones of contamination on the site. For each of these strategic options, there are a number of potential technical approaches, but the technical baseline is to use existing mature technology (TRL 9).</p> <p>For options in which some radioactive contamination remains in situ during C&M and does not decay to below regulatory concern prior to Final Site Clearance, the technical baseline assumes that residual contamination will be removed by excavation for off-site disposal during Final Site Clearance.</p> <p>The main non-radioactive contamination issue at HPA is contamination by hydrocarbons, for which the technical baseline is to remove free hydrocarbon product from the ground (so far as is reasonably practicable) then deal with the remaining contamination of soils and groundwater principally by monitored natural attenuation. The technical baseline for dealing with non-radioactive contamination is to use existing mature technology (TRL 9).</p>					
10.2 1.1.1.24.13.36.2 4040.24365	Continued in-situ monitoring during C&M preparations and C&M	Site characterisation	Where contamination does not present a risk to the public and is not migrating across the site boundary, contamination may be left in the ground. If contamination remains during C&M, the C&M safety case will need to recognise this hazard and substantiate a case for its management. Management is likely to be primarily through groundwater monitoring (using boreholes) to check extent of contamination against projections.	9	That it will be possible to make a safety case, if considered necessary, which is acceptable to the regulators to manage remaining contamination during the remainder of C&M preparations and C&M by monitoring its extent against projections using groundwater monitoring boreholes.	Site safety case. Site discharge authorisations.	Extent of monitoring to be defined since site characterisation still to be completed. This will be developed along with the site land quality strategy required by ME/S/154.	Ref:- 120
10.3	Potential implementation during C&M preparations of enhanced containment measures or other controls	Site characterisation	Intervention might have to be deployed where further in situ control of the contamination is required. This could be achieved using a variety of conventional technologies. Remediation or intervention would be implemented in C&M preparations.	9	That if enhanced containment or control is needed, it can be adequately achieved using existing mature conventional technology.	Site safety case. Site discharge authorisations.	Requirement for enhanced containment or controls is still to be defined since site characterisation needs to be completed. The need would be identified in the site land quality strategy required by ME/S/154.	
10.4	Excavation and removal (during C&M Preparations and / or at Final Site Clearance)	Site characterisation	Where contamination presents a risk to the public, spreading to an unacceptable extent or represents an obstacle to de-licensing (for Final Site Clearance), then it may be necessary to excavate the contaminated material. LLW, dominated by Cs-137, will be packaged and disposed of to the National LLWR. Hydrocarbon contaminated material will be disposed of by an authorised waste management company.	9	That it will be possible to dispose of contaminated ground to the National LLWR. That treatment of the waste prior to disposal will not be necessary. That authorised waste management companies have capacity to process hydrocarbon contaminated material.	Availability of disposal routes. Site discharge authorisations.	Requirement for excavation is still to be defined since site characterisation still needs to be completed. Opportunities for treatment of LLW excavated material to reduce volume or remove activity have not been considered for HPA since current characterisation does not identify an issue. On site disposal of LLW ground is an alternative option to disposal at the national LLWR. On-site bioremediation of hydrocarbon contaminated material is an alternative option if significant	Excavation and disposal as LLW has been undertaken on a number of sites, most recently Bradwell and Berkeley.

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
							excavations required for on-site disposal are undertaken.	
11.0 1.1.1.24.13.32.2 4020.24060 1.1.1.24.13.32.2 4020.24106	Back to Bio-shield	Overview: Asbestos removal will have been completed in the boiler blower houses prior to commencing deplanting of the primary gas ducts, boiler and associated plant and equipment. The upper and lower gas ducts will be isolated at the gas valves and all external duct component removed and laid down, the boilers will then also be removed and laid down. Blower halls and boiler houses will have been deplanted as described above to facilitate removal of boilers and gas ducts and the final demolition of the boiler and blower houses.						Ref: 20, 55, 56, 57 Table 3 Task 11.0.1 MEL DSO R&D Back to Bioshield <i>Project Deferred</i>
11.1	Disconnection of Primary Circuit	Active Plant removal	R1 and R2 Circuit isolation and sealing consists of separating the gas ducts at the gas valve and sealing the reactor vessel boundary. The Reactor vessels will then be prepared for safestore by isolation and sealing.	7	The gas valves will provide an adequate isolation for works associated with removal of the gas ducts and boilers. The dose rates local to the gas valves will permit man access to remove the gas ducts. All works associated with removal of gas ducts will be performed manually assisted with appropriate conventional lifting equipment.	The practicality and radiological implications of sealing the circuits as close to Reactor as possible. Physical space constraints around the gas duct labyrinths.	The scope of this work is still being developed. All work should be achievable	Info from BNLS See section 11
11.2	Removal of Boiler houses	Removal of the Boilers	The Boiler house walls will have the upper sections removed initially prior to removal of the boilers. The boilers will then be removed via the north side of the reactor buildings and laid down on prepared hard standings. Thereafter, the boiler blower houses will be demolished. The pile cap roof will then be lowered over the Pilecap, leading to an overall Reactor building height reduction. A new Reactor Building roof will be installed about 10 metres above the Pilecap and be integrated with the safe store enclosure.	7	The structural stability of the boiler houses can be maintained in a partially deconstructed state to facilitate boiler removal.	Controlled demolition of the boiler houses.	The scope of this work is still being developed.	See section 11
11.3	Removal of the Boilers	Removal of Boiler houses	R1 and R2 Boilers and Ducts will be removed via suitable openings through the north and south sides of the boiler houses and the Heat Exchangers laid down and prepared for safestore by the addition of blanking over all apertures.	7	That adequate space is available on site to configure the lifting equipment to remove the boilers from each boiler house..	Stability of civil structure to permit adequate structural dismantling to facilitate boilers removal.	The scope of this work is still being developed.	See section 11
12.0	Safe Store Preparations	Overview: The current Lifetime Plan strategy is to create a “Reactor Safestore” that would safely contain an amount of plant and equipment within the existing Reactor building for a period of up to 100 years. The building will be clad in weatherproof sheeting. The end state of the site for C&M Preps is one of much reduced visual impact that will be safe & robust to remain in a quiescent state for the period of C&M.						Ref: 20 & 23

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
12.1 1.1.1.24.11.11.2 4020.24032	Modifications and Cladding	Back to Bio Shield	Following removal of the boiler blower houses and each pond complex the remaining parts of Reactor building will have cladding installed or renewed to form the final Safestore building.	6	The approach will be to clad the building, the main roof having been lowered and secondary roof installed, to seal the bioshield structure against water ingress. The safestore cladding is assumed to have a life of 40 years.	Predicted durability of modern cladding materials is currently being researched at Dungeness – true life expectancy therefore not defined.	Longevity of cladding panels	<i>Ref:- 103</i> <i>Table 3;</i> <i>Task ID 12.1.2</i> <i>RWDTG scope element N21/08</i> <i>Long term integrity of building cladding panels.</i>
13.0	Care & Maintenance	<p>Overview: The end state of the site following completion of the C&M Preps phase will comprise of the reactor buildings reduced to the limit of the bioshield and clad for safestore and the ILW store together with any services required to maintain the site through the C&M period. All other buildings will have been demolished to ground level; voids filled and made safe, and the site partially landscaped to ensure that no hazards, e.g. water hazards, may collect over time.</p> <p>The remaining hazards on the site, the reactors, primary gas circuit components and ILW store will be in a safe, secure, fully contained, protected and robust condition for the duration of C&M to allow radioactivity to decay to lower levels prior to FSC. Packaged ILW will be removed from site to a National ILWR when it becomes available.</p>						Ref. 20
13.1 1.1.1.24.15.51.24 075.24300 1.1.1.24.15.51.2 4040.24117 1.1.1.24.11.13.2 4020.24140	C&M	Safe Store Preps	<p>The site will be in a passively safe state requiring minimal human intervention as most hazards, including those that were the most active and potentially mobile, will have been removed or immobilised.</p> <p>Cladding panels which make up the safe store of the reactor building will be replaced at 40 year periods.</p>	7	During the C&M phase the site will not require upgrades arising from the periodic safety reviews.	Legislation and requirements of the C&M safety case.	Longevity of panels used for safestore cladding	Ref: 24, 27 Table 3; <i>Task ID 12.1.2</i> <i>RWDTG scope element N21/08</i> <i>Long term integrity of building cladding panels.</i>
13.2 1.1.1.24.13.33.2 4040.24117 1.1.1.24.13.33.2 4075.24140	Inspection, maintenance and security		<p>Site will be monitored from a security lodge, key indication and alarms having been fed back to alarm and indication panels, walkdowns of the reduced RCA will identify damage to panels combined with indication from building sumps to identify significant water ingress. Based on inspection and indication maintenance will be scheduled.</p> <p>Ongoing monitoring of contaminated land.</p>	9	That the site will be manned throughout the C&M period. That alarms will not be repeated off site at a central control facility.	Safety case requirements and Regulatory requirements for the C&M phase	C&M phase safety case and requirements for substantiation.	
13.3 1.1.1.24.16.60.2 4040.24260	Periodic site inspection		To satisfy the maintenance schedule and requirements of Periodic Safety Review the remaining site will undergo a defined inspection regime, predominantly this will involve structural assessment of the remaining structure and weather envelope.	9	Periodic Safety Reviews will need to be completed every 10 years.	Existing site licence condition 15 requiring periodic review of the site safety case.	Specific requirements for inspection during C&M still to be identified and agreed.	
13.4	ILW package inspection		<p>Periodically dummy waste packages will be recovered from the ILW store vault for inspection purposes. Packages will be recovered and handled using the installed package handling machine and dedicated maintenance / inspection cell.</p> <p>NB. See section 9.7 for full details and R&D</p>	8			See section 9.7 for full details and R&D	See section 9.7 for full details and R&D

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
13.5 1.1.1.24.14.41.2 4035.24220	ILW Store emptying		The ILW store will be emptied using the installed package handling machine through the import export route into a RWMD overpack transporter.	7	The RWMD overpack and transporter will be designed to be able to interface with the HPA docking port arrangement without the requirement to provide a transit transfer facility.	The ILW store docking snout arrangement, import bay and package handling machine	The RWMD export transporter has still to be designed.	Ref:- 97 See section 9.8 for full details and R&D
13.6 1.1.1.24.13.34.2 4035.24215	Demolish ILW Store		Following emptying of the ILW store the facility will be characterised, any areas of contamination remediated and the ILW store demolished using conventional tools and techniques.	9	There will be no significant penetrating contamination of the ILW store concrete structure.	ILW store structure		
14.0	Final Site Clearance	Overview: At the end of the FSC period all of the hazardous and radioactive material, above agreed limits, including that below ground level, will have been removed from the site and all structures removed to at least ground level with any below ground level voids back-filled where necessary for safety reasons. Finally, the Site will be subjected to extensive radioactivity surveys to confirm that no unacceptable radioactivity remains on or below the site and that the site can be delicensed.						Ref. 11, 12 & 13, 55, 56, 57 Table 3 Task ID 14.0.1 MEL DSO R&D Final Site Clearance <i>Project Deferred</i> Task ID 14.0.2 MEL DSO R&D Alternative Disposal Options <i>Project Deferred</i>
14.1 1.1.1.24.11.11.2 4020.24480 1.1.1.24.11.13.2 4030.24390	Preparatory Works and Access Reactor Pressure Vessel	C&M activities	Necessary site infrastructure is re-introduced to the site to support Final Site Clearance including necessary waste handling facilities, services, accommodation, encapsulation plant etc. The reactor bioshield structures will be modified to facilitate the dismantling operations. This will include the construction of access and waste routes to the pile cap level as well as well as lifting equipment and shielded facilities. Control rods and other long items will be removed from the reactor cores and surrounding voids. Open access routes into the space between the steel Reactor Pressure Vessel (RPV) and the concrete bioshield. Break through the pile cap and into the RPV. Conventional industrial diamond drilling and cutting procedures will be used to prepare access route to RPV	7	The bioshields have not deteriorated and are able to support the dismantling structural requirements.		Final site clearance strategy.	Table 3 Task ID 14.0.1 MEL DSO R&D Final Site Clearance <i>Project Deferred</i>
14.2 1.1.1.24.11.12.2 4035.24420	Waste process plant		This new facility will receive, sort and package all the FSC ILW in RWMD compliant boxes.	8	That the waste handling facilities will be capable of processing and packaging the waste at the required rate.	The selected RWMD box technical constraints and requirements. The infrastructure required	Investigate alternative disposal options	Table 3 Task ID 14.0.2 MEL DSO R&D Alternative Disposal

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
1.1.1.24.11.12.2 4035.24495					That the waste will not be grouted.	to handle and transport the selected RWMD compliant boxes.		Options <i>Project Deferred</i>
14.3 1.1.1.24.13.34.2 4020.24485	Preliminary Reactor Dismantling		Erect containment between the top of the RPV, the newly formed sides of the penetration in the pile cap and a discharge route to the waste management facility. Install lighting and Closed Circuit Television (CCTV) in the RPV. Progressively remove the Guide Tube Assemblies. Lower two Remote Handling Machines (RHM) through hole at top of RPV onto graphite core. Cutting and size reduction operations to be executed using the RHM's.	5	Remote Handling Machines (RHM) to be used in the RPV are presently based on proprietary equipment such as Brokk vehicles. That the radiological conditions will permit man access to remove thermal insulation from upper RPV and create access for and assist in setting up the ROV's.	The reach and load capacity of the RHM. Umbilical management.	Underpinning of technical solution.	Table 3 Task ID 14.0.1 MEL DSO R&D Final Site Clearance <i>Project Deferred</i>
14.4 1.1.1.24.13.34.2 4020.24485	Graphite Removal		Remote Handling Machines will be used to remove the reactor core moderator bricks starting at centre and working outwards. Brick removal to be repeated layer by layer until the base level diagrid is reached.	7	Displaced bricks to be transferred in skips to the pile cap for disposal via the newly constructed waste route / processing facility. The graphite will be disposed of in the National deep underground repository.	National deep underground repository will accept the graphite	Disposal route for Graphite material needs to be identified and agreed with stakeholders.	Table 3 Task 14.4.1 MEL DSO R&D Graphite Disposition <i>Project Deferred</i>
14.5 1.1.1.24.13.34.2 4020.24485	RPV Dismantling		Sides of RPV cut away down to the diagrid level. Discarded material to be transferred to the pile cap in skips and disposed of via the existing waste facilities and waste routes.	9	The RPV will be cut away using conventional industrial procedures utilising the external scaffolding/staging. The radiological conditions will allow manual operations	That dose rates and conventional safety issues will necessitate the use of remote handling techniques.	More sampling of reactor components to verify the current inventory	
14.6 1.1.1.24.13.34.2 4020.24485	Reactor Support Structure Dismantling		Remove the diagrid and remaining steelwork located in the void below the RPV. Discarded material to be transferred to the pile cap in skips and disposed of via the existing waste facilities and waste routes.	9	The removal the diagrid and remaining steelwork will be done using conventional industrial procedures.			
14.7 1.1.1.24.13.34.2 4020.24490	Radial Shield and Bioshield Removal		The active layer of the inner surface of the bioshield will be removed first using large diameter circular saws fixed to walls. Survey and monitor remaining building structure, decontaminate as appropriate and demolish utilising industry standard techniques.	8	That the depth of active concrete is as estimated. That the saw support/transfer system is effective.	Diameter of blade. Structure of wall for retaining the saw.	Further concrete cores to be taken to underpin the depth of active concrete. Underpinning of technical solution.	Table 3 Task ID 14.0.1 MEL DSO R&D Final Site Clearance <i>Project Deferred</i>
14.8 1.1.1.24.13.34.2 4035.24425	Decommission waste process plant		Removal of all newly constructed waste handling facilities, services, accommodation and encapsulation plant. All contaminated plant and equipment will be appropriately decontaminated and fed into an appropriate waste route	8	That the waste handling facilities will be capable of processing and packaging the plant they contain. That a temporary mobile effluent / encapsulation facility will		Underpinning of technical solution.	Table 3 Task ID 14.0.1 MEL DSO R&D Final Site Clearance

Task / Process ID.	Task/Process description	Preceding task	Technique	TRL	Assumptions	Technical constraints	Gaps (ref to R&D table)	Key reference documents
1.1.1.24.13.34.2 4035.24500					be available to handle final waste streams.			<i>Project Deferred</i>
14.9 1.1.1.24.13.34.2 4030.24455	FSC Site Infrastructure Dismantling		Numerous items of plant and buildings outside the RCA require demolition during the FSC phase. Conventional techniques will be utilised	9	Disposal routes will be available for conventional demolition wastes during FSC.			
15.0	Site End State	Overview: The end point of FSC period is assumed to be a delicensed site with all structures removed to at least ground level, landscaped and planted with appropriate locally indigenous flora thus allowing the site to be made available for any alternative appropriate use. Ground level voids will be backfilled where necessary for safety reasons. Any remaining significant areas of contaminated land will be removed. The entire site within the outer fence will be regraded and covered with imported topsoil. The site will be subjected to detailed and extensive radioactivity surveys to confirm no unacceptable radioactivity remains. Once confirmed, the Nuclear Site Licence requirement can be removed and the site will no longer be subject to the requirements of an RSA93 Authorisation.						
15.1 1.1.1.24.13.36.2 4040.24510	Contaminated Land	Final Site Clearance	Non-radioactive (chemical) and Radioactive ground contamination characterisation, monitoring and site hydro-geological mapping work will be carried out. Any contamination found will be removed or contained, <i>consistent with the clean up plan developed from the final site survey results.</i>	9	It is assumed the site end state will be as defined in section 15.0 above.	Excavation and removal requires consideration of the options for treatment, storage and disposal of the resulting waste.	Adequate characterisation and understanding the end state is essential to ensure that the correct amount of remediation is done and the site can be delicensed. Further characterisation will be required during FSC to underpin delicensing of the site.	<i>Ref:- 119</i> Table 2, Task ID 10.1.1 Site Contaminated Land Characterisation Survey.
15.2 1.1.1.24.13.37.2 4040.24465	Site Radiological Clearance	Contaminated Land	Demonstrate that ‘no hazard’ remains on site	9	Definition of no hazard does not change prior to delicensing			BNLS delicensing Winfrith delicensing
15.3 1.1.1.24.13.37.2 4040.24460	Landscaping		The land will be landscaped to make it acceptable for future usage.	9				

Table 1B: Hinkley Point A - Technical Baseline (Work that has been completed or deleted)

Task / Process ID.	Task/Process description	Identification of change	Impact of change
1.8	Waste Sampling & Characterisation	To improve the clarity of the baseline, and in particular the research and development activities this entails, the waste sampling and characterisation work associated with management of the wet wastes has been broken out to create a specific line item within the baseline.	None, this work needed to be performed but was previously covered within other wet waste line items.
2.7	Waste Sampling and Characterisation	To improve the clarity of the baseline, and in particular the research and development activities this entails, the waste sampling and characterisation work associated with management of the solid wastes has been broken out to create a specific line item within the baseline.	None, this work needed to be performed but was previously covered within other solid waste line items.
3.8	Export of Legacy Fuel	Fuel recovered during fuel free verification and desludging activities in both R1 & R2 ponds will need to be exported to Sellafield in an M2 fuel flask.	Work was identified in previous detailed volumes for the Ponds Decommissioning project. One further flask will need to be introduced to each pond to facilitate the export of the material via the currently installed despatch route. Sellafield will need to provide two further M2 flasks for this purpose.
4.1	Interim storage	Activity removed – All skips retrieved from the skip store and placed in interim storage. See Task / Process ID 4.3.	None
4.2	Retrieval of skips from skip store and segregation of waste	Activity removed – All skips retrieved from the skip store and placed in interim storage. See Task / Process ID 4.3.	None
4.4	Processing of MCI recovered from pond skips	Section remove, work activities associated with this task are covered within Task/Process ID 3.4	None - R&D activity Task ID 4.4.1 re-identified as 3.4.3
5.0	Orphan Waste	Activity and associated sub-sections removed as all work completed	None
5.1	FED currently stored in pond skips awaiting transfer to Wet Vault.	All FED transferred from pond to associated wet vault	None
5.2	Segregation of FED from MAC.	All FED and MAC segregated.	None
5.3	Size reduction of MAC.	All MAC size reduced and transferred to the associated wet vault	None
5.4	Segregation of waste stored in ETP lower vault and the NCAW store.	All waste originally stored in the ETP lower vault of the NCAW has been segregated into ILW and LLW. The ILW has been repacked and stored in the NCAW in readiness for the solid ILW project to package and the LLW has been packed into HHISO containers for disposal to the National LLWR.	None

Table 2: Hinkley Point A - Research and Development Table (Work that is progressing in FY 2008-09)

Red italic text signifies additions and changes to the text in the tables since the previous issue.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
<i>1.1.2 Wet ILW retrieval & conveyance</i>	<i>Identify and trial standard slurry handling tools and techniques.</i>	<i>Investigate use of standard industry tools to convey Wet ILW</i>	<i>March 2009</i>	<i>>£50k</i>	<i>Opportunity Risk 24-24021-73 Wet ILW may be received from other sites for conditioning and storage.</i>	<i>Site / Generic</i>	<i>Deployment of and operator training in the use of conventional slurry pumping tools and techniques to handle material to be recovered. Report on the use of various slurry conveying pumps to optimise wet ILW recovery.</i>
1.2.2 Organic resin packaging solutions	Identify and develop alternative organic resin waste packaging solutions to reduce packaged waste volumes.	Packaging organic resin in a cementitious matrix requires careful pre-processing and produces a waste package with a poor waste loading effectively bulking up packaged	2008/09	£100k to £1M	Opportunity Risk 24-24021-29		Selection of BPM resin packaging solution underpinned by R&D trials. <i>Linked to R&D covered in section 1.5</i>
<i>Task ID 1.2.3 Assess results of failed resin packaging trials.</i>	<i>Results from R&D Task ID 1.2.1 indicate that the proposed packaging solution does not meet RWMD requirements</i>	<i>All waste streams need an LoC to agree the identified means of immobilisation meets RWMD requirements for the repository. The result from the long term packaging trials for organic IX Resin indicate that the waste product does not remain sufficiently stable and shows signs of deterioration.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need Risk</i>	<i>Site / Generic</i>	<i>Organic IX Resin trials review report. Proposal for further programme of R&D to support cementation of organic IX Resin.</i>
1.4.1 Assessment of waste water arisings.	Volume and composition of waste water arisings from Wet ILW Processing needs to be determined.	Volume and composition of waste water arisings needs to be understood to determine required process capability.	2008/09	>£50k	Need Risk	Site	Input to 'Products and secondary wastes report' and 'Process mass balance'. <i>Aligned to R&D items 1.2.2 & 1.5.1</i>
1.4.2 AETP condition.	Assessment of AETP condition to ensure tanks affected by the Sulphur Reducing Bacteria have not been significantly degraded and still provide an adequate level of primary containment.	The AETP tanks and vessels have hosted a Sulphur Reducing Bacteria which may have attacked components in the system causing the components to be weakened. Of particular concern are the tanks used to store active material which are installed in secondary containment/shielded structures and cannot physically inspected without the use of specialist tooling	2008/09	£50k - £100k	Need Risk	Site	Inspection programme. Condition report.. Recommendations for corrective actions. Ref 110
<i>1.5.14 Glass formulation trials.</i>	<i>Glass waste form development trials</i>	<i>Need to understand glass chemistry with reference to HPA specific waste forms</i>	<i>Stage 1 – Jan '08 Stage 2 Stage 3</i>	<i>£100k - £1M</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Stage 1 desk top study to identify 8 potential waste formulations appropriate for HPA wastes which merit further development Completed Jan '08 - ref 88</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
			<i>Stage 4 - 2009/10</i>				<i>Stage 2 – Experimental trials report to deselect less appropriate waste forms. Stage 3 – Waste loading of remaining formulations Stage 4 – Process applicability to emergent waste forms identified during development programme.</i>
<i>1.5.15</i> <i>Off-gas analysis.</i>	<i>Understand composition of exhaust gas</i>	<i>Needed to develop exhaust gas abatement solution to meet requirements of site discharge limits. Linked to completion of phase 2 of table 2 section 1.5.12</i>	<i>August '08</i>	<i>£50k-£100k</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Exhaust gas composition report based on potential waste product and glass formulations.</i>
<i>1.5.17</i> <i>Investigate thermal decomposition of IX resin.</i>	<i>Thermal behaviour of IX resins</i>	<i>Need to understand how IX Resins degrade in high temperature environments in order to develop the chemistry of the process and the waste form.</i>	<i>2008/09</i>	<i>£50k-£100k</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Paper on the behaviour of IX Resins in high temperature environments.</i>
<i>1.5.20</i> <i>Develop waste package design.</i>	<i>Waste package design.</i>	<i>Current waste packages are designed around the use of cementitious encapsulant materials as such they are designed for ambient conditions with temperature extremes limited to less than 100°C, Vitreous waste products will expose the waste packages to significantly higher temperatures. The package design for a vitreous waste product therefore needs to be able to tolerate such high temperatures and be able to readily dissipate the heat to facilitate subsequent prompt handling of the waste package.</i>	<i>2008/09</i>	<i>£50k-£100k</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Design for a waste package outer container suitable for vitreous waste products.</i>
<i>1.5.23</i> <i>Secondary waste arisings.</i>	<i>Understanding of the secondary waste arisings resulting from thermal vitrification processing.</i>	<i>It is necessary to understand the composition of secondary wastes arising from thermal vitrification in order that a fully assessment of the plants impact can be made and that disposal routes can be identified for them.</i>	<i>2010/11</i>	<i>£50k-£100k</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Stage 1 – small scale sample analysis – 2008/09 Stage 2 – full scale sample analysis - through to 2011 Report on the Secondary Waste Arisings generated as a result of the Thermal Vitrification process.</i>
<i>1.5.24</i> <i>Vitrification operational plant design preparation</i>	<i>Operational Plant Design</i>	<i>In order to fully understand the implications for changing to a thermal vitrification process it is necessary to develop an operational plant design so that plant parameters and space requirements can be identified.</i>	<i>2010/11</i>	<i><£1M</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Operational Plant Design</i>
1.7.1	Assessment for the potential to reuse existing building for wet waste immobilisation. Potential to reduce waste volumes and construction costs.	There may be space in redundant facilities which would permit the siting of the wet waste immobilisation plant and equipment.	2008/09	>£50k	Opportunity	Site	Wet waste process plant siting option report.
<i>1.8.1</i> <i>Life cycle management of samples</i>	<i>Formal arrangements for lifecycle management of samples and associated analysis.</i>	<i>A formal arrangement is required to ensure that samples taken on site are adequately controlled and that the data obtained from characterising them suitably controlled in order to provide a robust auditable process. Arrangement to</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Site based MCP of LSI for management of waste samples and their associated analysis.</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
		<p><i>cover:</i></p> <p><i>Taking of samples</i></p> <p><i>Management of samples prior to analysis.</i></p> <p><i>Management Characterisation data</i></p> <p><i>NB. Currently covered on a sample by sample basis by specific written arrangement.</i></p>					
2.2.1 Retrieval Arm R&D trials	Requirement to identify performance envelope of a retrieval arm to confirm suitability for active operation and identify control requirements to aid operation.	<p>R&D trials are currently in preparation to underpin the selection and use of the Vault Retrieval Machine. Trials are to cover operability, controllability, viewing system and audio, performance trials, recoverability and vault protection systems. (Scope of work within the 06/07 LTP but still to be completed at this time.)</p> <p>Integration of the vault retrieval machine and its associated gamma gate and shielding with the existing vault structure and the waste transfer tray system.</p>	Commissioning Report March 2008 Waste recovery trials Sept 2008	£100k - £1M	<p>Need</p> <p>Risk</p> <p>24-24020-15 24-24020-17 24-24020-59 24-24020-60 24-24020-61 24-24020-62 24-24020-63 24-24020-66</p>	Site / Generic	<p>Commissioning Report.</p> <p>Retrieval arm R&D report. Forward action plan to develop prototype retrieval arm into production model.</p> <p>Operability Report to confirm arm can access vault envelope, recover waste, underpin waste recovery rates and operators can be trained to drive reliably using remote viewing equipment.</p>
2.2.9 Wet vault FED characterisation	Understanding of physical and radiological properties of the FED	Material characterisation (physical properties and radiological) of the FED will provide actual source term data against which the plant design can be developed	2008/09	>£50k	<p>Need</p> <p>Risk</p> <p>24-24020-18 24-24020-21 24-24020-69 24-24024-02</p>	Site	<p>Material characterisation report.</p> <p>-Recover material from both wet vaults and carry out initial on site gamma spec analysis. <i>Complete [114]</i></p> <p>-Transfer samples to lab for detailed radio-chemical analysis.</p> <p>NB. We have found FED material in R1 pond dating to Dry vault operating window and will sample at same time as taking wet vault samples.</p>
2.3.3 <i>NCAW waste inventory</i>	<i>Accurate NCAW waste inventory required to prepare design solutions.</i>	<i>Further characterisation of the MCI and MAC required to support the Solid ILW system process design and CLoC requirements. See Task ID 2.3.1</i>	2008/09	£50k - £100k	<p><i>Need</i></p> <p><i>Risk</i></p> <p><i>24-24020-82</i></p>	<i>Site</i>	<p><i>Detailed waste inventory and waste data sheets for total inventory.</i></p> <p><i>Conditions for acceptance document specifying plant interface requirements for waste donor plants.</i></p>
2.3.4 <i>Conditions for acceptance</i>	<i>To fix the physical and radiological properties of any MCI and MAC.</i>	<i>The physical and radiological properties of the waste need to be defined such that the solid ILW process plant can bound its design and the donor plants can condition their waste to minimise future handling requirements.</i>	2008/09	>£50k	<i>Need</i>	<i>Site</i>	<i>MCI and MAC Process Plant Conditions for Acceptance</i>
2.4.6 <i>Improved solid waste packaging solutions</i>	<i>Identify alternative solid waste packaging techniques. Develop and assess solution against technical baseline to select BPEO solution for solid waste process and packaging.</i>	<i>Alternative solutions to the immobilisation of solid ILW waste streams have not been researched to provide a robust BPEO justification for the use of cementitious grouts for infiltration. The use of cementitious grouts does not allow for any compaction of the raw waste since adequate infiltration of the waste is not achievable without the use of superplasticisers which does not currently meet RWMD</i>	2009/10	100k - £1M	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>BPEO document underpinning selected waste packaging solution</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
		<i>waste packaging requirements.</i>					
<i>2.4.7 Metal refining techniques</i>	<i>Assess viability of refining Magnox metal into saleable magnesium commodity.</i>	<i>An alternative solution to FED waste packaging not previously investigated is the recovery and resale of the magnesium as an asset. Dependent on material purity and commodity market values the presents an opportunity to recoup some of the cost of the waste packaging plant whilst generating a significant reduction in the volume of ILW requiring storage at HPA. This is desk top type R&D to achieve a TRL of 3 proving concept has sufficient viability for consideration as an improved waste packaging solution in Task ID 2.4.6.</i>	<i>November 2008</i>	<i>£100k - £1M</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Technology viability report – If viable report to substantiate a minimum TRL of 3.</i>
<i>2.7.1 Dry vault FED characterisation (Representative)</i>	<i>Representative characterisation of solid ILW from dry Magnox vaults. (Based on FED material removed from R1 Pond.)</i>	<i>The dry FED vaults cannot be sampled at present due to an NSC instruction. A full physical properties and isotopic inventory of the FED waste stream is required to bound the process and structural design of the process plant</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Site</i>	<i>Dry FED vault characterisation report – based on material removed from R1 pond during orphan waste/desludging campaign likely to have come from fuel elements the FED of which would have been stored in the Dry Vault</i>
<i>3.2.5 OSD HPA review</i>	<i>Assess the adequacy of the generic On Site Disposal Solution for HPA.</i>	<i>The HPA Design Authority needs to satisfy itself regarding the adequacy of the proposed solution and associated documentation / submissions to meet the requirements for the potential storage of HPA LLW inventory on site.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need / Opportunity</i> <i>Risk: 24-24001-07 24-24001-19 24-24008-20</i>	<i>Site / Generic</i>	<i>Generic On Site Disposal scheme assessment report and action plan.</i>
<i>3.3.2 Alternative Ionsiv packaging technologies</i>	<i>To identify a means of immobilising the Ionsiv material in a form acceptable to RWMD.</i>	<i>An acceptable means of processing and packaging the Ionsiv material needs to be selected and underpinned. In particular this needs to consider the thermal processing techniques currently identified for the other HPA wet waste streams for there suitability to handle the Ionsiv material.</i>	<i>2009/10</i>	<i>>£50k</i>	<i>Need / Opportunity</i> <i>Risk: 24-24008-16 24-24008-34 24-24008-41</i>	<i>Site / Generic</i>	<i>Ionsiv process and packaging options report (Addendum to the Wet Waste processing options report).</i>
<i>3.3.4 DCI drum design optimisation</i>	<i>To optimise the design of the Ductile Cast Iron (DCI) drum into which the Ionsiv cartridges are placed to achieve satisfactory shielding performance within the weight limit of the installed structure and handling equipment.</i>	<i>The DCI drum will need to be handled within the Ponds. If the design of the DCI drum is not optimised then it is probable that the existing structure will require strengthening and lifting equipment replacing for relatively few operations.</i>	<i>2009/10</i>	<i>£50k - £100k</i>	<i>Need / Opportunity</i> <i>Risk: 24-24008-20 24-24008-21</i>	<i>Site</i>	<i>Stage 1 – Health Physics dose rate survey of Ionsiv cartridges. 2008/09 Stage 2 – DCI drum design and shielding assessment. 2009/10</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
3.5.1 Pond decontamination technology	Investigate means of controlling contamination during the pond draining phase to minimise its spread and reduce worker exposure to airborne hazard.	As a pond is drained a contaminated surface is revealed. As the surface dries out contamination can be released/spread around the ponds complex by air flow presenting a radiological hazard to the workforce.	2008/09 & 2009/10	£50k - £100k	Need Risk: 24-24033-79	Site / Generic	Stage 1 – Assessment of surface decontamination techniques prior to draining pond. <i>Complete [93]</i> Stage 2 – Assessment of fixative materials and application during draining Stage 3 – Management of residual particulate following draining of ponds. BPM case for selection of appropriate process to control the spread of contamination.
3.5.2 <i>Pond ventilation system assessment</i>	<i>Assessment of the adequacy of the extant pond ventilation systems for pond draining activities.</i>	<i>During draining of the ponds the effective area of the building increases as does the surface area from which contaminations could be released. The extant vent system needs to be assessed to ensure that it is either capable of managing the containment requirements of the facility or that modifications are identified.</i>	<i>March '11</i>	<i>£100k – £1M</i>	<i>Need Risk: 24-24033-79</i>	<i>Site</i>	<i>Stage 1 - Initial capability assessment March '09 Stage 2 - Revised system design March '11</i>
3.8.1 <i>Plant condition review.</i>	<i>Back end fuel route plant and equipment hasn't been used since defuelling of the reactors was completed in 2004.</i>	<i>A small quantity of fuel has been found in the ponds during preparatory activities to their draining. Before the ponds are drained this fuel need to be exported to Sellafield. The only licensed means of transferring the fuel is an M2 fuel flask as used during operation and defuelling. The equipment used to handle fuel flasks has not been used for a number of years and now needs to be brought into service to handle a final flask from each pond.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need Risk: 24-24033-62 24-24033-63 24-24033-73</i>	<i>Site</i>	<i>Back end fuel route plant condition report and remedial action plan.</i>
3.8.2 <i>R2 fuel despatch</i>	<i>Investigate whether there is an alternative solution to exporting residual R2 fuel through the extant route</i>	<i>It was not anticipated that residual fuel would be found within the R2 ponds. As a result of this the R2 back end fuel route safety case was not claimed in the Rebaselined Post Defuelling Safety Case. Therefore a new Safety Case will need to be made to reinstate and operate the R2 fuel route for the final shipment.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Site</i>	<i>Optioneering report supporting the best practicable means for exporting the residual fuel from R2.</i>
4.3.1 <i>Skip store skips decontamination process</i>	<i>Identify an alternative means for decontaminating the skip store skips.</i>	<i>The skip store skips have had a latex based coating applied which does not behave as the original surface coating which the ADF was design to remove. The subsequent waste generated by Ultra High Pressure Water Jetting creates a waste stream which the back end waste handling equipment cannot handle which results in the installed plant becoming blocked and operators having to recover the problem.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Site</i>	<i>Optioneering report supporting the selection of the Best Practicable Means for decontaminating the skip store skips.</i>
6.1.4 <i>PWTP & AETP capability assessment</i>	<i>Assess PWTP & AETP capability against projected arisings</i>	<i>Need to identify if there are any future arising which have potential to challenge the existing abatement plants capability. Potential to define the point at which METP is required and its performance requirements.</i>	<i>2007/08</i>	<i>>£50k</i>	<i>Need Risk: 24-24029-33 24-24084-06 24-24084-14 24-24084-26</i>	<i>Site</i>	<i>Assessment of PWTP & AETP against projected future arisings.</i>
7.3.1 <i>SPF9F</i>	<i>In situ chemical decontamination of plant and</i>	<i>Closed systems like the Pond water treatment plants are heavily contaminated with activity coating and engrained in</i>	<i>Phase 1 – Sept 2008</i>	<i>£50k - £100k</i>	<i>Opportunity</i>	<i>Site / Generic</i>	<i>Phase 1 – Lab scale trials R&D report. Phase 2 – Report for in-situ decontamination of</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
<i>DFDX chemical decontamination trials</i>	<i>equipment has the potential to offer significant benefits in: Reducing worker dose exposure during deplanting activities.</i> <ul style="list-style-type: none"> • <i>Improved decontamination performance.</i> • <i>Significant reduction of the contamination hazard during deplanting.</i> • <i>Deplanting performance.</i> 	<i>the wetted surface of the components. During deplanting this contamination presents hazards to the workers in terms of radiological dose uptake and the potential for inhaling, ingesting or injecting contamination. Decontamination of the plant prior to deplanting has the potential to significantly reduce all these hazards and enable operative to work in more normal conditions, without respirators and additional protective clothing, potentially increasing productivity.</i>	<i>Phase 2 March 2009</i>				<i>SPF9F.</i>
<i>8.1.3 Asbestos survey</i>	<i>Management of Asbestos Regulations</i>	<i>Compliance with Asbestos legislation.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Site</i>	<i>Site asbestos survey report</i>
10.1.1 Site Contaminated Land Characterisation Survey.	Develop site knowledge of the contamination location and their movement.	Continued groundwater monitoring biannually, 2 reports /yr. Determine which bore holes are worth continuing to monitor. Engage with EA.	2014/15	>£50k	Need	Site	Survey Reports
<i>10.1.4 Land Quality Management Plan.</i>	<i>Management plan for areas of contaminated land and areas still to be characterised.</i>	<i>Need to define areas of contaminated land are to be managed into the future and when uncharacterised areas will be sampled</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Site</i>	<i>Land Quality Management Plan.</i>
15.1 Site End State	Understanding the End State	Understanding the end state of the site will define the strategy needed to get there, especially in respect to on-site disposal and contaminated land remediation.	2008/09	>£50k	Need	Site	Stakeholder meetings and Regulatory acceptance of the end-state through consultation meetings.

Table 2A: Hinkley Point A - Research and Development Table (Work that is on-hold for FY 2008-09)

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
1.5.2 Wet waste process and packaging plant throughput modelling.	Initial Operational Research (OR) model required to underpin the performance objectives of the wet waste plant and the selection of the BPEO process and packaging solution.	Modelling of plant throughput is critical to the development of plant design solutions and the selection of appropriate plant and equipment to meet the plants design throughput.	<i>Project Deferred</i>	£50k to £100k	Need	Site	Justification of selected waste process and packaging option.
1.3.1 Produce BPEO for gas drier desiccant.	There is no identified BPEO solution for packaging the gas drier desiccant.	Gas drier desiccant is an ILW waste stream for which a packaging solution is required which will need to be substantiated for storage through the C&M phase in the site ILW store	<i>Project Deferred</i>	£50k	Need	Site / Generic	BPEO document underpinning selected waste packaging solution.
1.3.2 Gas drier desiccant characterisation	Material characterisation required to confirm waste disposal route and packaging solution.	The majority of the drier desiccant is still in the gas circuit humidriers and has not been recovered and characterised. Waste form is therefore poorly understood; this information will confirm activity levels and therefore the waste stream and provide additional data to confirm encapsulation formulation prior to trials.	<i>Project Deferred</i>	£50k	Need	Site	Waste characterisation data sheet
1.3.3 Tritium discharge resulting from encapsulation	Need to assess volume of tritium to be released during encapsulation and the adequacy of current tritium discharge authorisation	Desiccant release tritium during the encapsulation process as a result of mixing with a cementitious grout. The volume of the potential release needs to be assessed against our existing discharge authorisation to ensure it is not breached.	<i>Project Deferred</i>	£50k	Need	Site	Tritium discharge calculation to underpin selection of BPEO
<i>1.5.16 Revised discharge authorisation for Vitrification plant.</i>	<i>Revise schedule 5 of RSA93 authorisation</i>	<i>Need to negotiate with the EA a mutually acceptable set of limits for the operation of a thermal process plant at HPA.</i>	<i>R&D scope deferred</i>	<i>£50k-£100k</i>	<i>Opportunity</i>	<i>Site / Generic</i>	<i>Revised RSA93 discharge authorisation to permit the operation of a production plant</i>
<i>1.5.18 Investigate impact performance of glass waste forms.</i>	<i>Impact performance of glass waste forms.</i>	<i>At present ILW package performance substantiation is based on cementitious grout encapsulation of waste streams. In order to underpin a vitreous waste product R&D is required to underpin how vitreous waste products behave in similar scenarios.</i>	<i>2010/11</i>	<i>£50k-£100k</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Substantiation report on the impact performance of vitreous waste product packages</i>
<i>1.5.19 Radiation tolerance of</i>	<i>Radiation tolerance of glass waste forms in high radiation</i>	<i>At present ILW package performance substantiation is based on cementitious grout encapsulation of waste streams. In</i>	<i>2009/10</i>	<i>£50k-£100k</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Substantiation report on the behaviour of vitreous waste product packages in high radiation</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
<i>glass waste forms in high radiation environment s.</i>	<i>environments.</i>	<i>order to underpin a vitreous waste product R&D is required to underpin how vitreous waste products behave in high radiation environments.</i>					<i>environments.</i>
1.5.21 <i>Pilot plant – inactive trials</i>	<i>Inactive trials</i>	<i>In order to prove the thermal vitrification process it will be necessary to build a Pilot Plant for performance of further R&D. The initial stage of this would build to full scale trials using simulant materials of the identified waste streams</i>	<i>R&D scope deferred</i>	<i><-£1M</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Inactively commissioning wet waste Pilot Plant. Inactive simulated waste packages. Inactive commissioning report Inactive trials report TRL of 8 for the process.</i>
1.5.22 <i>Pilot plant – active trials</i>	<i>Active trials</i>	<i>In order to prove the thermal vitrification process it will be necessary to build a Pilot Plant for performance of further R&D. The second stage of this would build to full scale trials using HPA active waste materials.</i>	<i>R&D scope deferred</i>	<i>£100k-£1M</i>	<i>Opportunity / Need</i>	<i>Site / Generic</i>	<i>Actively commissioning wet waste Pilot Plant. Active waste package/s. Active commissioning report Active trials report Support reference to RWMD stage 3 LoC TRL of 9 for the process and waste</i>
2.1.1 Vault fire system modelling	Modelling of gas flows within the Magnox splitter vane vaults (dry vault)	In order to substantiate the required environment to extinguish or prevent a fire the dispersion and diffusion of gases within the waste retrieval facility, Magnox vault and waste pile need to be modelled. Further R&D may then be necessary to substantiate the plants capability to meet the requirements of the model.	2010/11 R&D scope deferred	>£50k	Need Risk 24-24020-58	Site	Vault fire model, Fire suppression system R&D report, Design substantiation report.
2.2.2 Vault gravel characterisation.	The gravel material at the bottom of the dry vault is not identified in any of the stations records. The material and format will affect method of retrieval and processing.	The gravel material at the bottom of the vault is not specified and neither do records show its make up. R&D will be required to recover and identify a sample of the material to confirm physical properties. Further R&D will be required for retrieval, process and encapsulation of the material.	2014/15 R&D scope deferred	£50k - £100k	Need Risk 24-24020-64 24-24020-65	Site	NB. It is likely that a serviceable Vault fire suppression system will need to be available before waste in the vault can be disturbed. Physical properties and radiochemical analysis report for a gravel sample from each dry vault. Forward action plan for further R&D to underpin gravel handling element of plant design.
2.2.3 Alternative wet Fed retrieval solutions	Identify alternative retrieval techniques for the wet vault FED	Trials have been performed within the wet vault to demonstrate that a hydraulically operated clam shell grab can be deployed and recovered safely. However alternative technologies are available which may improve operability and better manage the spread of contamination.	<i>2010/11 R&D scope deferred</i>	£50k - £100k	Opportunity Risk 24-24020-19 24-24020-67	Site / Generic	Technology search report and an optioneering paper to select the Best Practical Means for wet vault FED recovery.
2.2.7 Wet vault remote viewing solutions	Remote viewing of the wet vault will be required during retrieval operations due to requirements for remote operation.	Further development of viewing requirements for satisfactory wet vault operations. Development of camera deployment system to ensure flexibility and coverage of vault contents.	<i>2010/11 R&D scope deferred</i>	>£50k	Need Risk 24-24020-70	Site / Generic	Selected camera solution/s deployed in wet vault to gain experience of the system in the operational environment.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
2.2.8 Fines segregation	Physical removal of fines from solid waste.	The encapsulation technique for immobilising solid waste does not successfully immobilise fines. Fines content of waste packages is tightly controlled by RWMD. It may be necessary to demonstrate active management of any fines within the solid waste stream to satisfy the waste packaging specification.	2010/11 R&D scope deferred	£50k – £100k	Need Risk 24-24020-68	Site / Generic	Optioneering report to identify BPM solution, R&D report to demonstrate technology performance, design substantiation report to underpin RWMD submissions.
2.2.11	<i>Failure mode and effect analysis report for Waste Retrieval Machine.</i>	<i>In order to be able to substantiate the use of a Waste Retrieval Arm in a vault it is necessary to understand how it may fail, either in terms of the fault loads it could exert or the potential articulation failures which could lead to the arm becoming stuck in the vault. This information will enable strategies and solutions to be developed such that the vault structure/arm do not fail as a result of potential overload cases and that the arm is recoverable from all credible fault cases</i>	<i>2010/11 R&D scope deferred</i>	<i>>£50k</i>	<i>Need</i>	<i>Site / Generic</i>	<i>Failure modes and effects analysis report. Design Substantiate report for the recoverability of the arm.</i>
2.2.12	<i>Waste Retrieval Machine design load case assessment.</i>	<i>In order to be able to substantiate the use of the Waste Retrieval Machine in a vault it is necessary to understand how it may fail. One element of this is understanding the physical properties of the arm such that the control system can be designed to ensure that the arm cannot be overloaded in any orientation. NB crane loader arms are designed for the loads applied by the object and wind loads within specified limits. The design of a WRM needs to consider the potential faults loads applied to the arm in the event of a collision with another structural element.</i>	<i>2010/11 R&D scope deferred</i>	<i>>£50k</i>	<i>Need</i>	<i>Site / Generic</i>	<i>Waste Retrieval Arm Physical Properties Report.</i>
2.4.1 Solid waste process and packaging plant throughput modelling.	Confirm plant performance and that design can achieve the required throughput	The grouting and capping process dominates the box dwell time in the encapsulation facility. OR modelling is therefore essential for identifying number of grouting / capping locations and the required size of the encapsulation plant.	<i>2010/11 R&D scope deferred</i>	£50k - £100k	Need	Site	OR model to underpin concept design.
2.4.2 Grout infiltration R&D.	Need to identify grout formulation for infiltrating waste forms.	RWMD stipulate tight limits on voidage within grouted packages. R&D is required to identify the appropriate grout formulation and water cement ratio to satisfy this requirement for all solid wastes. R&D should also identify further grout issues arising from the formulation and water content, such as bleed water.	2010/11 R&D scope deferred	£50k - £100k	Need	Site	Box grouting trials report. Identified grout formulation and water / cement ratio for waste forms. Future R&D resulting from selected grout formulation
2.5.1 Cross site transporter alignment trials	Need to demonstrate the repeatability of the cross site transporter alignment system and its performance tolerance.	Trials are required to prove that the control system 'line following' technology has the ability to repeatedly and accurately follow the marker system and park itself within the necessary tolerance range of the package handling cranes in the various facilities.	2010/11 R&D scope deferred	£50k - £100k	Need Risk 24-24020-77	Site	Demonstration that cross site transporter can reliably and repeatedly position itself within tolerance limits required by the ILW store docking port and 'External Interfaces Document'

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
2.6.1 RWMD box base stiffening	Confirm box stiffening device adequately reinforces the base of the RWMD box restricting deflections within acceptable tolerances	3m ³ RWMD box bases are produced from a flat sheet of stainless steel. When handled using cranes prior to grouting the box bases have been shown to deflect beyond acceptable limits (potentially plastically) for future safe storage.	2010/11 R&D scope deferred	£50k - £100k	Need	Site / Generic	Developed design for incorporation into RWMD box to stiffen the base. Design substantiation for stiffened base.
2.7.2 Dry vault FED Characterisation (Actual)	<i>Characterisation of solid ILW from dry Magnox vaults. (Based on material removed from both R1 & R2 Dry Vaults)</i>	<i>A full physical properties and isotopic inventory of the FED waste stream is required to bound the process design and underpin the waste packaging LoC</i>	<i>2014/15 R&D scope deferred</i>	<i>>£50k</i>	<i>Need</i> <i>Risk:</i> <i>24-24020-94</i>	<i>Site</i>	<i>R1 & R2 Dry FED vault characterisation report</i>
3.1.2 Discharge Shaft characterisation	<i>Detailed knowledge of the discharge shaft structure is required in order to develop processes for its decontamination and refine the waste inventory</i>	<i>Radiological activity has been absorbed into the structure of the discharge shaft through its operational life. The depth of penetration is not constant and varies with a number of factors, depth below water, atmospheric conditions, geometry and the properties of the concrete and surface coatings.</i> <i>In order to develop a design for decontaminating the discharge shaft structure it is necessary to know the depth of material which will need to be removed from the structure in order to reveal a clean surface and the activity and composition of the waste material to be removed</i>	<i>March 2011 R&D scope deferred</i>	<i>£100k - £1M</i>	<i>Need</i> <i>Risk:</i> <i>24-24033-66</i>	<i>Site</i>	<i>Discharge Shaft characterisation survey report</i>
3.1.3 Transit Bay characterisation	<i>Detailed knowledge of the transit bay structure is necessary in order to develop processes for its decontamination and refine the waste inventory</i>	<i>Radiological activity has been absorbed into the structure of the transit bay through its operational life. The depth of penetration is not constant and varies with a number of factors, depth below water, atmospheric conditions, geometry and the properties of the concrete and surface coatings.</i> <i>In order to develop a design for decontaminating the transit bay structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</i>	<i>March 2011 R&D scope deferred</i>	<i>£100k - £1M</i>	<i>Need</i> <i>Risk:</i> <i>24-24033-66</i>	<i>Site</i>	<i>Transit Bay characterisation survey report</i>
3.1.4 General pond structures characterisation.	<i>Detailed knowledge of the general pond structures is required in order to develop processes for its decontamination and refine the waste inventory</i>	<i>Radiological activity has been absorbed into the structure of the General Pond buildings through their operational life. The depth of penetration is not constant and varies with a number of factors, depth below water, atmospheric conditions, geometry and the properties of the concrete and surface coatings.</i> <i>In order to develop a design for decontaminating the pond general structures it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</i>	<i>March 2010 R&D scope deferred</i>	<i>£100k - £1M</i>	<i>Need</i> <i>Risk:</i> <i>24-24033-66</i>	<i>Site</i>	<i>General Pond Structures characterisation survey report</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
3.1.5 <i>Ponds post draining detail characterisation.</i>	<i>Further detailed knowledge of the pond structure is required in order to further develop processes for its decontamination and refine the waste inventory</i>	<i>Radiological activity has been absorbed into the structure of the pond through its operational life. The depth of penetration is not constant and varies with depth, geometry and the properties of the concrete and surface coatings.</i> <i>In order to develop a design for decontaminating the pond structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</i>	<i>2014/15 R&D scope deferred</i>	<i>£100k - £1M</i>	<i>Need Risk: 24-24033-66</i>	<i>Site</i>	<i>Pond post draining characterisation survey report</i>
3.1.6 <i>Magnox vaults characterisation.</i>	<i>Detailed knowledge of all the Magnox Vault structures will be required in order to develop processes for its decontamination and refine the waste inventory</i>	<i>Radiological activity has been absorbed into the structure of the Magnox vaults through their operational life. The depth of penetration is not constant and varies with depth, geometry and the properties of the concrete and surface coatings.</i> <i>In order to develop a design for decontaminating the Magnox vaults it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</i>	<i>2021/22 R&D scope deferred</i>	<i>£100k - £1M</i>	<i>Need Risk: 24-24033-66</i>	<i>Site</i>	<i>Magnox vault characterisation survey report</i>
3.1.7 <i>Dry skip store characterisation.</i>	<i>Detailed knowledge of the Dry Skip Store structure is required in order to develop processes for its decontamination and refine the waste inventory</i>	<i>Radiological activity has been absorbed into the structure of the dry skip store through its operational life. The depth of penetration is not constant and varies with a number of factors, water ingress, atmospheric conditions, geometry and the properties of the concrete and surface coatings.</i> <i>In order to develop a design for decontaminating the dry skip store structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</i>	<i>2012/13 R&D scope deferred</i>	<i>>£50k</i>	<i>Need Risk: 24-24033-66</i>	<i>Site</i>	<i>Dry skip store characterisation survey report</i>
3.1.8 <i>Pond pump rooms characterisation.</i>	<i>Detailed knowledge of the pond pump room structure in order to develop processes for its decontamination and refine the waste inventory</i>	<i>Radiological activity has been absorbed into the structure of the pond pump room through its operational life. The depth of penetration is not constant and varies with a number of factors, water leaks, flooding, atmospheric conditions, geometry and the properties of the concrete and surface coatings.</i> <i>In order to develop a design for decontaminating the pond pump room structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</i>	<i>2012/13 R&D scope deferred</i>	<i>>£50k</i>	<i>Need Risk: 24-24033-66</i>	<i>Site</i>	<i>Pond pump room characterisation survey report</i>
3.2.4 <i>Asbestos management</i>	<i>Type 3 Asbestos survey</i>	<i>Prior to demolition of significant reworking of a structure an invasive type 3 asbestos survey of the area or building will be completed.</i>	<i>2023/24 R&D scope deferred</i>	<i>£50k– £100k</i>	<i>Need</i>	<i>Site</i>	<i>Type 3 Survey report</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue	Key outputs / Actions
<i>t</i>							
3.3.1 <i>Ionsiv characterisation</i>	<i>Non invasive characterisation of Ionsiv cartridges.</i>	<i>The Ionsiv material needs characterising to facilitate its future handling and processing. The Ionsiv resin is sealed in a stainless steel casing such that it cannot be physically sampled without breaching the containment should invasive means be required. Therefore a non-invasive technique needs to be used and agreed with relevant stakeholders.</i>	2009/10	£50k – £100k	<i>Need</i> <i>Risk:</i> 24-24008-39 24-24008-52	<i>Site</i>	<i>Ionsiv cartridges characterisation report</i>
3.3.3 <i>Ionsiv formulation trials</i>	<i>To demonstrate that the selected packaging technique is capable of producing a waste acceptable to RWMD.</i>	<i>Prior to developing a design for processing the Ionsiv material it is necessary to demonstrate that the technology can produce a repeatable compliant waste form.</i>	2010/11	£50k – £100k	<i>Needs</i>	<i>Site / Generic</i>	<i>Ionsiv ILoC submission substantiation report.</i>
3.7.1 Contaminated structure demolition	Produce arrangements for the control of contaminated structure demolition	Not all structures can be decontaminated prior to starting demolition, arrangements are therefore required to identify acceptable means of controlling the demolition, and the arisings, of contaminated structures	2022/23 R&D scope deferred	>£50k	<i>Need</i> <i>Risk:</i> 24-24033-75	<i>Site / Generic</i>	Guidance document on the control of contaminated structure demolition.
6.1.3 <i>PWTP & AETP decommissioning strategy</i>	<i>Identify optimal transfer point for treatment of aqueous arisings by the METP.</i>	<i>A Best Practicable Means justification for an METP will need to be made. This justification will need to be made on an assessment of the existing plants ability to continue to process arisings through to end of life against a requirement to decommission the plant without impacting on the sites schedule to enter care and maintenance. Identification of the optimal transfer point to an METP is key to correctly sizing and specifying the abatement requirements for an METP.</i>	2014/15	£50k - £100k	<i>Need / Opportunity</i> <i>Risk:</i> 24-24029-33 24-24084-06 24-24084-14 24-24084-26	<i>Site / Generic</i>	<i>PWTP & AETP decommissioning strategy report. – Identify the Best Practicable Means Solution to decommissioning the facilities. Requirements functional specification for MAETP equipment required to support PWTP & AETP decommissioning.</i>
10.1.3 <i>Under Building Sampling and Characterisation.</i>	<i>Knowledge of ground conditions beneath existing building foundations.</i>	<i>The ground conditions beneath the main structures is largely unknown. The foundations to the majority of the main structures are to be left in situ. In order to demonstrate that no hazard remains when delicensing the site or parts thereof it will be necessary to remove samples for analysis.</i>	2014/15	< £1M	<i>Need</i>	<i>Site</i>	<i>Under Building Characterisation and Management Plan</i>

Table 2B: Hinkley Point A - Research and Development Table .(Work that has been completed or deleted)

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
1.1.1 Wet ILW retrieval & conveyance	Identify and trial standard slurry handling tools and techniques.	Hydrotrans system may be over complex for handling the HPA Wet ILW. Investigate use of standard industry tools to recover and pump Wet ILW	March 2007	>£50k	Work completed.	Deployment of and operator training in the use of conventional slurry pumping tools and techniques to handle material to be recovered from representative waste tanks; Regen Neutralising Tanks (RNT's) and Fine Filter Settling Tanks (FFST's). Ref 82B - HINA/WILW/REP/134 Iss 1 28/03/07
1.1.2 Wet ILW retrieval & conveyance	Material handling performance could be improved	A number of retrieval tools have been trialled however it was identified that further improvements could be made with some further R&D carried out to improve the "conveying" pump.	2008/09	>£50k	Additional R&D to underpin wet waste retrieval solution.	Deployment of and operator training in the use of conventional slurry pumping tools and techniques to handle material to be recovered. Report on the use of various slurry conveying pumps to optimise wet ILW recovery.
1.2.1 Resin waste form stability trials	Complete long term RWMD waste form stability trial.	To satisfy RWMD requirements on package stability a set of trials are performed using stimulant materials, these are monitored over a period of time (~2 years) to assess waste form stability.	Completion March 2008	>£50k	Work on schedule to complete March 2008 Risk: 24-24021-74	Waste form stability report. [83]
1.2.3 Assess results of failed resin packaging trials.	Results from R&D Task ID 1.2.1 indicate that the proposed packaging solution does not meet RWMD requirements	All waste streams need an LoC to agree the identified means of immobilisation meets RWMD requirements for the repository. The result from the long term packaging trials for organic IX Resin indicate that the waste product does not remain sufficiently stable and shows signs of deterioration.	2008/09	>£50k	Resin waste form stability trials Task ID 1.2.1 above indicate that the formulation used in preparing the samples has failed to meet the RWMD requirements for waste form stability. This task reviews Task ID 1.2.1 to identify potential failings and to propose a further programme of R&D to underpin organic IX resin cementation.	Organic IX Resin trials review report. Proposal for further programme of R&D to support cementation of organic IX Resin.
1.5.1 Improved wet waste packaging solutions.	Identify alternative wet waste packaging techniques. Develop and assess solution against technical baseline to select BPEO solution for wet waste process and packaging.	Alternative solutions to the immobilisation of wet ILW waste streams have not been researched to provide a robust BPEO justification for the use of cementitious grouts. Cementitious grouts bulk up the waste inventory once packaged – research may incorporate resin packaging solution.	March 2008	£100k - £1M	Work on schedule to complete March 2008	BPEO document underpinning selected waste packaging solution – Ref 86 Conceptual Letter of Compliance for vitrified waste at HPA – Ref 88
1.5.11 Glass based waste product acceptability for ILW.	Acceptability of glass based waste product	Required to substantiate the BPEO position for wet ILW which identified significant benefits from a vitrified waste form.	December 2007	>£50k	Work completed December '07	CLoC for HPA wet waste conditioned as a vitreous waste product [87].

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
1.5.12 Independent assessment of optioneering report.	Independent assessment of review wet waste optioneering report.	An independent review by an acknowledge expert in environmental legislation will ensure that the Wet Waste Optioneering Summary Report is best placed to satisfy the Regulators requirements and expectations for a BPEO report.	2007/08	>£50k	Work on schedule to complete March 2008	Wet waste optioneering review and recommendations report
1.5.13 Categorisation of plasma arc type technology.	To assess thermal vitrification processes against “Reducing Environment” and “Incineration” criteria.	In order to understand how a thermal vitrification plant will be permissioned and licensed it is necessary to understand the chemistry which occurs in the reaction vessel this may either be termed “Reducing” (not incineration) or “Incinerating” justification of the environment within the reaction vessel is key to gaining consent from the regulators.	2007/08	£50k-£100k	Work on schedule to complete March 2008	Paper to identify and substantiate the prevailing condition within the reaction vessel required to achieve a compliant vitreous waste product. Ref: 112
1.5.14 Glass formulation trials.	Glass waste form development trials	Need to understand glass chemistry with reference to HPA specific waste forms	Stage 1 – Jan ‘08 Stage 2 Stage 3 Stage 4 - 2009/10	£100k - £1M	Additional R&D required to support a thermal waste processing solution.	Stage 1 desk top study to identify 8 potential waste formulations appropriate for HPA wastes which merit further development Completed Jan ‘08 - ref 88 Stage 2 – Experimental trials report to deselect less appropriate waste forms. Stage 3 – Waste loading of remaining formulations Stage 4 – Process applicability to emergent waste forms identified during development programme.
1.5.15 Off-gas analysis	Understand composition of exhaust gas	Needed to develop exhaust gas abatement solution to meet requirements of site discharge limits. Linked to completion of phase 2 of table 2 section 1.5.12	August ‘08	£50	Additional R&D required to support a thermal waste processing solution.	Exhaust gas composition report based on potential waste product and glass formulations.
1.5.16 Revised discharge authorisation for Vitrification plant.	Revise schedule 5 of RSA93 authorisation	Need to negotiate with the EA a mutually acceptable set of limits for the operation of a thermal process plant at HPA.	2009-10	£50k-£100k	Additional R&D required to support a thermal waste processing solution.	Revised RSA93 discharge authorisation to permit the operation of a production plant
1.5.17 Investigate thermal decomposition of IX resins	Thermal behaviour of IX resins	Need to understand how IX Resins degrade in high temperature environments in order develop the chemistry of the process and the waste form.	2008/09	£50k-£100k	Additional R&D required to support a thermal waste processing solution.	Paper on the behaviour of IX Resins in high temperature environments.
1.5.18 Investigate impact performance of glass	Impact performance of glass waste forms.	At present ILW package performance substantiation is based on cementitious grout encapsulation of waste streams. In order to underpin a vitreous waste product R&D is required to underpin how vitreous waste products behave in similar scenarios.	2010/11	£50k-£100k	Additional R&D required to support a thermal waste processing solution.	Substantiation report on the impact performance of vitreous waste product packages

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
waste forms						
1.5.19 Radiation tolerance of glass waste forms in high radiation environments.	Radiation tolerance of glass waste forms in high radiation environments.	At present ILW package performance substantiation is based on cementitious grout encapsulation of waste streams. In order to underpin a vitreous waste product R&D is required to underpin how vitreous waste products behave in high radiation environments.	2009/10	£50k-£100k	Additional R&D required to support a thermal waste processing solution.	Substantiation report on the behaviour of vitreous waste product packages in high radiation environments.
1.5.20 Develop waste package design	Waste package design.	Current waste packages are designed around the use of cementitious encapsulant materials as such they are designed for ambient conditions with temperature extremes limited to less than 100 ⁰ C, Vitreous waste products will expose the waste packages to significantly higher temperatures. The package design for a vitreous waste product therefore needs to be able to tolerate such high temperatures and be able to readily dissipate the heat to facilitate subsequent prompt handling of the waste package.	2008/09	£50k-£100k	Additional R&D required to support a thermal waste processing solution.	Design for a waste package outer container suitable for vitreous waste products.
1.5.21 Pilot plant – inactive trials	Inactive trials	In order to prove the thermal vitrification process it will be necessary to build a Pilot Plant for performance of further R&D. The initial stage of this would build to full scale trials using simulant materials of the identified waste streams	2009/10	<-£1M	Wet Waste Pilot Plant and Inactive Trials	Inactively commissioning wet waste Pilot Plant. Inactive simulated waste packages. Inactive commissioning report Inactive trials report TRL of 8 for the process.
1.5.22 Pilot plant – active trials	Active trials	In order to prove the thermal vitrification process it will be necessary to build a Pilot Plant for performance of further R&D. The second stage of this would build to full scale trials using HPA active waste materials.	2009/10	£100k-£1M	Wet Waste Active Trials using Pilot Plant	Actively commissioning wet waste Pilot Plant. Active waste package/s. Active commissioning report Active trials report Support reference to RWMD stage 3 LoC TRL of 9 for the process and waste
1.5.23 Secondary waste arisings.	Understanding of the secondary waste arisings resulting from thermal vitrification processing.	It is necessary to understand the composition of secondary wastes arising from thermal vitrification in order that a fully assessment of the plants impact can be made and that disposal routes can be identified for them.	2010/11	£50k-£100k	Additional R&D required to support a thermal waste processing solution.	Report on the Secondary Waste Arisings generated as a result of the Thermal Vitrification process.
1.5.24 Vitrification operational plant design preparation	Operational Plant Design	In order to fully understand the implications for changing to a thermal vitrification process it is necessary to develop an operational plant design so that plant parameters and space requirements can be identified.	2010/11	<£1M	Additional R&D required to support a thermal waste processing solution.	Operational Plant Design
1.8.1 Life cycle management of samples	Formal arrangements for lifecycle management of samples and associated analysis.	A formal arrangement is required to ensure that samples taken on site are adequately controlled and that the data obtained from characterising them suitably controlled in	2008/09	>£50k	Due to number of samples to be taken and resultant management of the characterisation data a formal management arrangement will be	Site based MCP of LSI for management of waste samples and their associated analysis.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
		order to provide a robust auditable process. Arrangement to cover: Taking of samples Management of samples prior to analysis. Management Characterisation data NB. Currently covered on a sample by sample basis by specific written arrangement.			beneficial.	
2.2.4 Wet vault residual waste eductor trials.	Selection of appropriate eductor and end effectors for residual waste recovery operations	The eductor used in original trials proved to be too large and adequate flow rate	March '07	>£50k	R&D Completed	Trials report, input to wet vault operational philosophy, input to design basis, forward action plan for further development of solution. [113]
2.2.5 Wet vault furniture cutter trials.	Demonstrate cutter life and clearance of cut section.	Hydraulic cutter to be tested to confirm adequate life expectancy and that cut section clear the cutters and do not cause jams.	March '07	In 2.6	R&D Completed	Hydraulic cutter trial report. Forward action plan if appropriate. [113]
2.2.6 ROV tractive effort trials	Investigate tractive effort of ROV on simulated surfaces	Vault furniture removal trials carried out on dry land, need to confirm that ROV has appropriate tractive effort on wet vault surface treatment for furniture removal tasks.	March '07	In 2.6	R&D Completed	ROV tractive effort trials report Forward action plan if appropriate [113]
2.2.10 Waste sorting and box loading system.	Waste characteristics when being manipulated.	Need to develop waste handling tools which can manipulate site specific wastes to give confidence in the technical solution. Two key areas are with respect to waste sorting where a remotely operated tool will be used to sort through and level FED on the transfer tray and box loading to ensure optimum box loading.	March '08	£50k - £100 k	R&D Completed Risk: 24-24020-71	Development trials report – incorporation of findings in baseline design. (Revised trials specification if necessary) [115]
2.2.11	Failure mode and effect analysis report for Waste Retrieval Machine.	In order to be able to substantiate the use of a Waste Retrieval Arm in a vault it is necessary to understand how it may fail, either in terms of the fault loads it could exert or the potential articulation failures which could lead to the arm becoming stuck in the vault. This information will enable strategies and solutions to be developed such that the vault structure/arm do not fail as a result of potential overload cases and that the arm is recoverable from all credible fault cases	2011/12	>£50k	Additional R&D to support the deployment of a Waste Retrieval Arm into a waste vault.	Failure modes and effects analysis report. Design Substantiate report for the recoverability of the arm.
2.2.12	Waste Retrieval Machine design load case assessment.	In order to be able to substantiate the use of the Waste Retrieval Machine in a vault it is necessary to understand how it may fail. One element of this is understanding the physical properties of the arm such that the control system can be designed to ensure that the arm cannot be overloaded in any orientation. NB crane loader arms are designed for the loads applied by the object and wind loads within specified limits. The	2011/12	>£50k	Additional R&D to support the deployment of a Waste Retrieval Arm into a waste vault.	Waste Retrieval Arm Physical Properties Report.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
		design of a WRM needs to consider the potential faults loads applied to the arm in the event of a collision with another structural element.				
2.3.1 Orphan waste inventory	Accurate orphan waste inventory required to prepare design solutions.	A full inventory of the Orphan ILW waste stream is not currently available – work completed to segregate solid LLW from ILW. <i>(Further characterisation required of the ILW to satisfy system process design and CLoC requirements. See Task ID 2.3.3)</i>	2008/09	>£50k	Initial characterisation complete	Detailed waste inventory and waste data sheets for total inventory. [118]
2.3.3 Orphan waste inventory	Accurate NCAW waste inventory required to prepare design solutions.	Further characterisation of the MCI and MAC required to support the Solid ILW system process design and CLoC requirements. See Task ID 2.3.1	2008/09	£50k - £100k	Additional R&D to support the development of the MCI & MAC process plant.	Detailed waste inventory and waste data sheets for total inventory. Conditions for acceptance document specifying plant interface requirements for waste donor plants.
2.3.4 Conditions for acceptance	To fix the physical and radiological properties of any MCI and MAC.	The physical and radiological properties of the waste need to be defined such that the solid ILW process plant can bound its design and the donor plants can condition their waste to minimise future handling requirements.	2008/09	>£50k	Additional R&D to support the development of the MCI & MAC process plant.	MCI and MAC Process Plant Conditions for Acceptance
2.7.1 Dry vault FED characterisation (Representative)	Representative characterisation of solid ILW from dry Magnox vaults. (Based on FED material removed from R1 Pond.)	The dry FED vaults cannot be sampled at present due to an NSC instruction. A full physical properties and isotopic inventory of the FED waste stream is required to bound the process and structural design of the process plant	2008/09	>£50k	R&D required to support development of process and waste packaging design.	Dry FED vault characterisation report – based on material removed from R1 pond during orphan waste/desludging campaign likely to have come from fuel elements the FED of which would have been stored in the Dry Vault
2.7.2 Dry vault FED characterisation (Actual)	Characterisation of solid ILW from dry Magnox vaults. (Based on material removed from both R1 & R2 Dry Vaults)	A full physical properties and isotopic inventory of the FED waste stream is required to bound the process design and underpin the waste packaging LoC	2014/15	>£50k	R&D required to support development of process and waste packaging design.	R1 & R2 Dry FED vault characterisation report
3.1.1 R1 & R2 long pond wetted structure characterisation.	Detailed knowledge of the pond structure in order to develop processes for its decontamination and refine the waste inventory	Radiological activity has been absorbed into the structure of the pond through its operational life. The depth of penetration is not constant and varies with depth, geometry and the properties of the concrete and surface coatings. In order to develop a design for decontaminating the pond structure it is necessary to know the depth of material which will need to be removed from the structure in order to reveal a clean surface and the activity and composition of the waste material to be removed	2007/08	£50k - £100k	R&D complete – report issued [92]	Long pond wetted surface characterisation survey report
3.1.2 Discharge Shaft characterisation	Detailed knowledge of the discharge shaft structure is required in order to develop processes for its decontamination and refine the waste inventory	Radiological activity has been absorbed into the structure of the discharge shaft through its operational life. The depth of penetration is not constant and varies with a number of factors, depth below water, atmospheric conditions, geometry and the properties of the concrete and	March '11	£100k - £1M	R&D required to support development of the discharge shaft decommissioning plan.	Discharge Shaft characterisation survey report

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
		<p>surface coatings.</p> <p>In order to develop a design for decontaminating the discharge shaft structure it is necessary to know the depth of material which will need to be removed from the structure in order to reveal a clean surface and the activity and composition of the waste material to be removed</p>				
3.1.3 Transit Bay characterisation	Detailed knowledge of the transit bay structure is necessary in order to develop processes for its decontamination and refine the waste inventory	<p>Radiological activity has been absorbed into the structure of the transit bay through its operational life. The depth of penetration is not constant and varies with a number of factors, depth below water, atmospheric conditions, geometry and the properties of the concrete and surface coatings.</p> <p>In order to develop a design for decontaminating the transit bay structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</p>	March '11	£100k - £1M	R&D required to support development of the discharge shaft decommissioning plan.	Transit Bay characterisation survey report
3.1.4 General pond structures characterisation.	Detailed knowledge of the general pond structures is required in order to develop processes for its decontamination and refine the waste inventory	<p>Radiological activity has been absorbed into the structure of the General Pond buildings through their operational life. The depth of penetration is not constant and varies with a number of factors, depth below water, atmospheric conditions, geometry and the properties of the concrete and surface coatings.</p> <p>In order to develop a design for decontaminating the pond general structures it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</p>	March '10	£100k - £1M	R&D required to support development of the general pond structure decommissioning plan.	General Pond Structures characterisation survey report
3.1.5 Ponds post draining detail characterisation.	Further detailed knowledge of the pond structure is required in order to further develop processes for its decontamination and refine the waste inventory	<p>Radiological activity has been absorbed into the structure of the pond through its operational life. The depth of penetration is not constant and varies with depth, geometry and the properties of the concrete and surface coatings.</p> <p>In order to develop a design for decontaminating the pond structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed</p>	March '14	£100k - £1M	R&D required to support further development of the Ponds decommissioning plan.	Pond post draining characterisation survey report
3.1.6 Magnox vaults characterisation.	Detailed knowledge of all the Magnox Vault structures will be required in order to develop processes for its decontamination and refine the waste inventory	<p>Radiological activity has been absorbed into the structure of the Magnox vaults through their operational life. The depth of penetration is not constant and varies with depth, geometry and the properties of the concrete and surface coatings.</p> <p>In order to develop a design for decontaminating the Magnox vaults it is necessary to know the depth of material</p>	March '22	£100k - £1M	R&D required to support development of the Magnox vault decommissioning plan.	Magnox vault characterisation survey report

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
		which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed				
3.1.7 Dry skip store characterisation.	Detailed knowledge of the Dry Skip Store structure is required in order to develop processes for its decontamination and refine the waste inventory	Radiological activity has been absorbed into the structure of the dry skip store through its operational life. The depth of penetration is not constant and varies with a number of factors, water ingress, atmospheric conditions, geometry and the properties of the concrete and surface coatings. In order to develop a design for decontaminating the dry skip store structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed	March '16	>£50k	R&D required to support development of the dry skip store decommissioning plan.	Dry skip store characterisation survey report
3.1.8 Pond pump rooms characterisation.	Detailed knowledge of the pond pump room structure in order to develop processes for its decontamination and refine the waste inventory	Radiological activity has been absorbed into the structure of the pond pump room through its operational life. The depth of penetration is not constant and varies with a number of factors, water leaks, flooding, atmospheric conditions, geometry and the properties of the concrete and surface coatings. In order to develop a design for decontaminating the pond pump room structure it is necessary to know the depth of material which will need to be removed in order to reveal a clean surface and the activity and composition of the waste material to be removed	March '16	>£50k	R&D required to support development of the pond pump room decommissioning plan.	Pond pump room characterisation survey report
3.2.4 Asbestos management	Type 3 Asbestos survey	Prior to demolition of significant reworking of a structure an invasive type 3 asbestos survey of the area or building will be completed.	Dec '23	£50k– £100k	Additional R&D to be undertaken to fully identify asbestos hazards prior to demolition.	Type 3 Survey report
3.2.5 OSD HPA review	Assess the adequacy of the generic On Site Disposal Solution for HPA.	The HPA Design Authority needs to satisfy itself regarding the adequacy of the proposed solution and associated documentation / submissions to meet the requirements for the potential storage of HPA LLW inventory on site.	2008/09	>£50k	Additional R&D required for HPA to assess the proposed generic LLW On Site Disposal Proposal for realisation at HPA.	Generic On Site Disposal scheme assessment report and action plan.
3.3.1 Ionsiv characterisation	Non invasive characterisation of Ionsiv cartridges.	The Ionsiv material needs characterising to facilitate its future handling and processing. The Ionsiv resin is sealed in a stainless steel casing such that it cannot be physically sampled without breaching the containment should invasive means be required. Therefore a non-invasive technique needs to be used and agreed with relevant stakeholders.	2009/10	£50k – £100k	Additional R&D to be undertaken to facilitate handling and process of the Ionsiv inventory.	Ionsiv cartridges characterisation report
3.3.2 Alternative Ionsiv packaging technologies	To identify a means of immobilising the Ionsiv material in a form acceptable to RWMD.	At present under NDA criteria the Ionsiv material is an “orphan” waste. Therefore an acceptable means of processing and packaging the material needs to be selected. In particular this needs to consider the thermal processing techniques currently identified for the other HPA wet waste streams for their suitability to handle the Ionsiv material.	2009/10	>£50k	Additional R&D to be undertaken to facilitate handling and process of the Ionsiv inventory.	Ionsiv process and packaging options report (Addendum to the Wet Waste processing options report).

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
3.3.3 Ionsiv formulation trials	To demonstrate that the selected packaging technique is capable of producing a waste acceptable to RWMD.	Prior to developing a design for processing the Ionsiv material it is necessary to demonstrate that the technology can produce a repeatable compliant waste form.	20010/11	£50k – £100k	Additional R&D to be undertaken to facilitate handling and process of the Ionsiv inventory.	Ionsiv ILoC submission substantiation report.
3.3.4 DCI drum design optimisation	To optimise the design of the Ductile Cast Iron (DCI) drum into which the Ionsiv cartridges are placed to achieve satisfactory shielding performance within the weight limit of the installed structure and handling equipment.	The DCI drum will need to be handled within the Ponds. If the design of the DCI drum is not optimised then it is probable that the existing structure will require strengthening and lifting equipment replacing for relatively few operations.	2009/10	£50k - £100k	Additional R&D to be undertaken to facilitate handling and process of the Ionsiv inventory.	Stage 1 – Health Physics dose rate survey of Ionsiv cartridges. 2008/09 Stage 2 – DCI drum design and shielding assessment. 2009/10
3.5.2 Pond ventilation system assessment	Assessment of the adequacy of the extant pond ventilation systems for pond draining activities.	During draining of the ponds the effective area of the building increases as does the surface area from which contaminations could be released. The extant vent system needs to be assessed to ensure that it is either capable of managing the containment requirements of the facility or that modifications are identified.	March '11	£100k – £1M	R&D identified to underpin the pond dewatering stage of the ponds decommissioning programme.	Stage 1 - Initial capability assessment March '09 Stage 2 - Revised system design March '11
3.6.1 Contaminated Structure Demolition	No change	No change	No change	No change	Item renumbered 3.7.1 to better correlate with the structure of the section.	No change.
3.8.1 Plant condition review.	Back end fuel route plant and equipment hasn't been used since defuelling of the reactors was completed in 2004.	A small quantity of fuel has been found in the ponds during preparatory activities to their draining. Before the ponds are drained this fuel need to be exported to Sellafield. The only licensed means of transferring the fuel is an M2 fuel flask as used during operation and defuelling. The equipment used to handle fuel flasks has not been used for a number of years and now needs to be brought into service to handle a final flask from each pond.	2008/09	>£50k	R&D identified to assess condition of plant and equipment in order to develop a remediation plan to bring it back into service.	Back end fuel route plant condition report and remedial action plan.
3.8.2 R2 fuel despatch	Investigate whether there is an alternative solution to exporting residual R2 fuel through the extant route	It was not anticipated that residual fuel would be found within the R2 ponds. As a result of this the R2 back end fuel route safety case was not claimed in the Rebaselined Post Defuelling Safety Case. It is therefore probable that a new safety case will need to be made to reinstate and operate the R2 fuel route for the final shipment.	2008/09	>£50k	R&D identified to assess potential alternative solutions to reinstating both R1 & R2 back end fuel routes.	Optioneering report supporting the best practicable means for exporting the residual fuel from R2.
4.3.1 Skip store skips decontamination process	Identify an alternative means for decontaminating the skip store skips.	The skip store skips have had a latex based coating applied which does not behave as the original surface coating which the ADF was design to remove. The subsequent waste generated by Ultra High Pressure Water Jetting creates a waste stream which the back end waste handling equipment cannot handle which results in the installed plant becoming blocked and operators having to recover the problem.	2008/09	>£50k	Operation of ADF identified that the skip store skips had an additional coating applied which cannot be handled by the existing plant. R&D required to identify the BPM solution to removing it.	Optioneering report supporting the selection of the Best Practicable Means for decontaminating the skip store skips.
6.1.1 Future aqueous	Identify optimal transfer point for treatment of aqueous arisings by the METP.	METP needs to be sized for the projected waste water arisings. The later the processing of waste water arising passes to the METP the smaller and cheaper this becomes.	March '08	>£50k	R&D completed	Site strategy report. <i>[Ref 85 - Galson Sciences Ltd report on active waste water arisings assessed existing plant as being fit for foreseeable future (Feb</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
arising projections for MAETP						'07)]
6.1.2 PWTP & AETP capability assessment	Identify optimal transfer point for treatment of aqueous arisings by the METP.	The capability of the existing treatment plant needs to be understood in order to identify if there is sufficient capability for the existing plant to handle the projected arisings through to end of life. If existing plant is not capable of providing sufficient abatement then it may be necessary to bring forward implementation of an MAETP thereby stipulating its required capacity.	2007/08	>£50k	METP R&D requirements further developed.. Completed	PTWP & AETP capability assessment [116] –
6.1.3 PWTP & AETP decommissioning strategy	Identify optimal transfer point for treatment of aqueous arisings by the METP.	A Best Practicable Means justification for an METP will need to be made. This justification will need to be made on an assessment of the existing plants ability to continue to process arisings through to end of life against a requirement to decommission the plant without impacting on the sites schedule to enter care and maintenance. Identification of the optimal transfer point to an METP is key to correctly sizing and specifying the abatement requirements for an METP.	2014/15	£50k - £100k	METP R&D requirements further developed.	PWTP & AETP decommissioning strategy report. – Identify the Best Practicable Means Solution to decommissioning the facilities. Requirements functional specification for MAETP equipment required to support PWTP & AETP decommissioning.
6.1.4 PWTP & AETP capability assessment	Assess PWTP & AETP capability against projected arisings	Need to identify if there are any future arising which have potential to challenge the existing abatement plant capability. Potential to define the point at which METP is required and its performance requirements.	2007/08	>£50k	METP R&D requirements further developed.	Assessment of PWTP & AETP against projected future arisings.
7.3.1 SPF9F DFDX chemical decontamination trials	In situ chemical decontamination of plant and equipment has the potential to offer significant benefits in: Reducing worker dose exposure during deplanting activities. <ul style="list-style-type: none"> Improved decontamination performance. Significant reduction of the contamination hazard during deplanting. Deplanting performance. 	Closed systems like the Pond water treatment plants are heavily contaminated with activity coating and engrained in the wetted surface of the components. During deplanting this contamination presents hazards to the workers in terms of radiological dose uptake and the potential for inhaling, ingesting or injecting contamination. Decontamination of the plant prior to deplanting has the potential to significantly reduce all these hazards and enable operative to work in more normal conditions, without respirators and additional protective clothing, potentially increasing productivity.	Phase 1 – Sept 2008 Phase 2 March 2009	£50k - £100k	Additional R&D identified which has potential to reduce worker dose uptake during decommissioning and the volume of waste requiring long term storage in a licensed radioactive waste repository.	Phase 1 – Lab scale trials R&D report. Phase 2 – Report for in-situ decontamination of SPF9F.
8.1.3 Asbestos survey	Management of Asbestos Regulations	Compliance with Asbestos legislation.	2008/09	>£50k	On schedule for completion March 2008.	Ponds asbestos survey report
10.1.2 Hydrocarbon pilot remediation study	Hydrocarbon pilot remediation study	Determine future remediation strategy for hydrocarbon contaminated land and manage interface with British Energy at Hinkley Point B.	2007/08	£50k	Pilot study due to complete March 2008 Risk 24-24019-08	Pilot study Report [119]
10.1.3 Under Building	Knowledge of ground conditions beneath existing building foundations.	The ground conditions beneath the main structures is largely unknown. The foundations to the majority of the main structures are to be left in situ. In order to	2014/15	£100k - £1M	Further contaminated land characterisation required prior to delicensing of the site or part thereof.	Under Building Characterisation and Management Plan

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
Sampling and Characterisation.		demonstrate that no hazard remains when delicensing the site or parts thereof it will be necessary to remove samples for analysis.				
10.1.4 Land Quality Management Plan.	Management plan for areas of contaminated land and areas still to be characterised.	Need to define areas of contaminated land are to be managed into the future and when uncharacterised areas will be sampled as required by ME/S/154.	2008/09	>£50k	Plan to outline contaminated land management requirements as required by ME/S/154.	Land Quality Management Plan.

Table 3: Magnox Electric Ltd. Waste and Decommissioning Research and Development Programme (Work that is progressing in FY 2008-09)*Red italic text signifies additions and changes to the text in the tables since the previous issue.*

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
1.3.4 Grout enclosure techniques.	A requirement has been identified for the need to develop a sealed inner container grout and characterisation techniques identified to condition tritium containing desiccant. Suitable grouts will be identified for a grout-enclosed concept and verify radiolysis would not lead to pressurisation of an inner container.	ILW Stores are designed to be “clean” the intent being that they would not have a discharge authorisation during their operational storage phase. Tritium being released during the storage period may require a discharge authorisation to be sought	2008/09	>£50k	Need	Generic RWDTG scope element N15/08	Feasibility report.
1.3.5 Handbook for the processing and immobilisation of desiccant waste	Knowledge management – capture of current knowledge and understanding regarding process and immobilisation requirements for the future.	Deferring decommissioning activities requires more staff to become familiar with the concept and processes for immobilising desiccant wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future.	2008/09	>£50k	Need	Generic Addresses NII AoC Ref:- NII/02, 05 & 07 RWDTG scope element N32/07	Key database – Handbook of the processing and immobilisation of desiccant waste.
1.5.6 Magnesium-hydroxide colloids in ponds wet wastes	Need to improve knowledge and understanding of the behaviour of magnesium hydroxide colloids with respect to waste processing plant to improve plant design basis.	This project investigates the effect of magnesium hydroxide colloid behaviour (in e.g. sludges) on plant in order to mitigate current and future problems in operational performance. Laboratory testing and assessment of plant data will be performed in connection with such problems. Modelling approaches will represent the chemistry, colloid formation, adsorption, settling, agglomeration, compression and separation behaviour of corrosion product sludges and suspensions	2008/09	£100k	Risk 24-24020-79	Generic Addresses NII AoC ref NII/01 & 02 RWDTG scope element S07/07	Develop improved understanding of Mg (OH) sludge behaviour. Identify potential difficulties prior to occurrence hence, thus saving money. Reduce plant down time, increase operational efficiency, better waste form.
1.5.7 Development of systems for ⁷⁹ Se and	Existing analytical techniques with respect to ⁷⁹ Se & ⁹⁹ Tc are not sufficient to obtain an appropriate LoC meaning disposal routes for certain waste	The purpose is the design, development, realisation and delivery of analytical techniques and methodologies for ⁷⁹ Se and ⁹⁹ Tc which will allow accurate determination of these radionuclides in specified waste streams.	2008/09 as part of 3-yr PhD	>£50k	Risk 24-24021-80	Generic Addresses NII AoC Ref:- NII/07	Demonstration of fit-for-purpose analytical techniques for ⁷⁹ Se and ⁹⁹ Tc consistent with RWMD and Regulatory expectations.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
⁹⁹ Tc analysis in ILW for RWMD compliance	streams may not be available.					RWDTG scope element N08/07	
1.5.8 Approaches to determine the radionuclide concentrations in ILW streams	Existing analytical techniques are not available for the qualification of all radionuclides which may be of interest to RWMD, so as to allow submission of stage 2 Letters of Compliance	The project is the collection, assimilation and clear presentation of existing information on the determination of radionuclide concentrations in ILW streams. Gaps in information will also be clearly identified and a brief statement of needs to rectify these, made.	2008/09	>£50k	Risk Risk 24-24021-81	Addresses NII AoC Ref:- NII/01, 02 & 05. RWDTG scope element N28/07	Will not be able to dispose of radionuclides if no analytical techniques are available. Underpinning of LoCs.
1.5.9 ILW Transportation. Project Ref 39/39052	Optimise new build solidification plant by transferring ILW to designated lead process site	At present each site needs to engineer its own arrangements for ILW process and encapsulation plant even where only small quantities of waste need to be processed and suitable plants are available at other sites Benefits could be realised by developing centralising waste processing plants for the ILW.	Stage 1 Raw waste transport containers. FY 2007/08 Stage 2 Raw waste transport container licensing. FY 2008/09 Stage 3 Raw Waste discharge transfer authorisation. FY 2009/10	£100k - £1M	Opportunity	Generic / NDA Issue Project Ref: 30/39052	Licensing of transportation system for unconditioned ILW. Stage 1 – Report on selection of Raw Waste Transfer containers. <i>Complete</i> Stage 2 – Investigation of licensing requirements for raw waste transport containers. Stage 3 – Raw waste discharge transfer authorisation for selected site. Trial transportation of unconditioned ILW
1.5.10 Handbook of the processing and immobilisation of organic IX resin wastes	The handbook of the processing and immobilisation of Magnox IX resin shall provide a comprehensive listing of all aspects of potential options for all Magnox ILW and LLW IX resins.		2008/09	>£50k	Need Risks: 24-24008-16 24-24008-34	Generic Addresses NII AoC Ref:- NII/02, 05 & 07, RWDTG scope	Key Database.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
						element S30/07	
1.5.25 Particulate science of magnesium hydroxide based materials in support of Magnox wet waste processing	Enhance the understanding of filtration processes enabling timely resolution of plant issues.	This project investigates the effect of particulate behaviour (in e.g. sludges) on plant in order to mitigate current and future problems in operational performance. Laboratory testing and assessment of plant data will be performed in connection with such problems. Modelling approaches will represent the chemistry, particle formation, adsorption, settling, agglomeration, compression and separation behaviour of corrosion product sludges and suspensions. (Linked to S07/07)	2008/09	>£50k	Opportunity	Generic Addresses NII AoC Ref:- NII/02 RWDTG scope element S04/07	Production of key reports with dissemination of information across UK sites. See also S07/07
Task 1.8.2 <i>Radiochemical analysis</i>	<i>Assess technical capability of the radiochemical characterisation industry to meet the demands placed on it by the UK civil nuclear decommissioning.</i>	<i>Inability to process samples will lead to delays in the development of design solutions and / or the processing of waste. Creating additional capacity takes time since resources need to be trained and facilities licensing.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Generic RWDTG scope element N29/08</i>	<i>Radiochemical analysis capability report</i>
2.3.2 <i>Deposition of WRATS and suspected orphans</i>	<i>Identification of routes and means for immobilisation of minor waste streams</i>	<i>Small volume waste streams have been identified and the project will determine if they are orphan wastes and investigate the best practice for management and / or waste disposal. Includes wastes such as zinc bromide, tank / silo residues, zeolite, skips etc.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Generic RWDTG scope element 01/08</i>	<i>Best practice report</i>
2.4.4 Gamma irradiation of cemented waste simulants	Demonstrate that cemented waste stimulant remains stable when irradiated.	In order to satisfy RWMD we need to be able to demonstrate that grouted stimulant waste remains stable under irradiated conditions in order justify the stability of the waste package monolith	2008/09 third year of 3 year programme	£100k - £1M	Need	Generic Addresses NII AoC Ref:- NII/06, 07 & 08. RWDTG scope element 14/07	Reference document justifying cemented waste forms.
2.4.5 Review of	There is a need to maximise the waste which can be grouted into	High grout fluidity will enable waste to be more tightly packed. This is because a grout with high fluidity will enter	2007/08	£50k -	Opportunity	Generic	Improved encapsulation techniques leading to fewer ILW containers on site.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
the use of selected inorganic superplasticisers in grouted wastes	storage containers. This in turn will reduce the number of waste containers required, which allows for large cost savings..	tighter gaps within the waste container. This project has the aim of improving the fluidity of grout by addition of inorganic superplasticisers. RWMD currently do not endorse organic based superplasticisers since there is not sufficient evidence that such organic superplasticisers do not have a detrimental effect on the long term properties of the waste form. Inorganic superplasticisers offer a potential alternative. This project aims to agree through discussion with RWMD a programme of work which will enable inorganic superplasticisers to be introduced for intermediate level waste.		£100k		Innovative Strategic Project managed by the DSO. Project ref No: 39/39056	
2.4.8 <i>Contaminated Gravel Treatment</i>	<i>To reduce the volume of material requiring encapsulation and management as ILW.</i>	<i>Gravel is used in the dry FED vaults as a buffer between the waste and the concrete structure designed to keep the FED out of any water lying at the bottom of the vault. As such the gravel will be contaminated but will not have been activated. Depending on the type of gravel used in the vaults it may be possible to decontaminate it below the ILW threshold saving a potential 10, 3m³ boxes of ILW.</i>	2008/09	>£50k	Opportunity	Generic RWDTG scope element N05/08	Feasibility study.
2.4.9 <i>Security of materials supply</i>	<i>Investigate securing the supply of materials essential for waste remediation.</i>	<i>Supply of materials is subject to market forces demand from the developing world for steel has driven steel prices up over last few years. Similar problems may be experienced obtaining cement powders and Blast Furnace Slag of an appropriate quality.</i>	2008/09	>£50k	Need Risk 24-24020-74	Generic RWDTG scope element 20/08	Supply security strategy.
2.4.10 <i>Use of Comb Superplasticisers</i>	<i>The ability to use superplasticisers in cementitious grouts may enable the use of compaction conditioning of FED materials to improve packing density prior to cementation.</i>	<i>The use of organic superplasticisers does not satisfy the RWMD packaging requirements. An alternative superplasticiser material has been identified and work was undertaken last year to irradiate the samples under W&D R&D scope element N14/07. This work is being assessed by RWMD who will provide their findings in FY 08/09. Delay to this may foreclose the use of superplasticisers in the design of waste process/packaging plants if favourable advice is not received during FY 08/09.</i>	2008/09	>£50k	Opportunity	Generic RWDTG scope element N25/08	Analysis of decay products and determination of the future use of comb super-plasticisers.
2.4.11 Handbook for the processing and encapsulation of	Knowledge management – capture of current knowledge and understanding regarding process and encapsulation requirements for the future. Knowledge management – capture of current knowledge	Deferring decommissioning activities requires more staff to become familiar with the concept and processes for solidifying FED wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future. Knowledge management – capture of current knowledge and understanding regarding process and encapsulation	2008/09	>£50k	Need	Generic Addresses NII AoC Ref:- NII/02, 05 & 07	Key database - Handbook of the processing and immobilisation of Magnox Fuel Element Debris (FED)

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
Magnox FED.	and understanding regarding process and encapsulation requirements for the future.	requirements for the future.				RWDTG scope element N31/07	
2.4.12 Integrated FED Solutions Project ref No: 39/39050	Overview: Similar to Wet ILW, a re-appraisal of the strategy for dealing with FED ILW might yield significant advantages. The current strategy for dealing with ILW is heavily based on the concept of immobilising all wastes without processing to achieve volume reduction. Direct encapsulation of waste is costly, and large potential financial savings could accrue from adopting volume reduction technology instead. Current estimates (excluding Berkeley, Dungeness and Trawsfynydd) indicate about 1100 3m ³ compliant waste boxes of encapsulated FED waste. Direct disposal costs alone are in the order of £100M. Whereas the current baseline cost for encapsulation facilities and increased storage capacity total £100Ms. The challenges to employing volume reduction technologies are not so much technical, but more regulatory and stakeholder issues. It has been assumed that regulators and the public may view volume reduction as environmentally “second best”. That may not be a fair assessment and indeed volume reduction may yield environmental benefits by increasing stability and passivity of the final waste form. The focus of this project is to examine the potential for decommissioning cost and time savings through application of appropriate FED volume reduction and processing technology.		2009/10	£100k - £1M	Opportunity to reduce technical risks of direct encapsulation of Magnox metal; Opportunity to reduce the number of waste packages to be disposed;	Generic/ND A issue Supports NII Ref NII/05; NII/06	Optioneering workshop output taking due account of stakeholder views via engagement. Generic BPEO for ILW disposition Concept design for Generic FED disposition solution.
2.6.3 RWMD box material	Review RWMD box materials to optimise storage life	Ensure optimum selection of waste package materials to maximise package storage life. Project will compile a list of alternative container materials including copper alloys, titanium alloys, nickel alloys, super austenitic, super duplex, composites and high strength concretes. It will also identify a range of performance measures and other criteria to permit a quantitative comparison with the use of 316L. <i>(Linked to S18/07)</i>	2008/09	>£50k	Opportunity	Generic Addresses NII AoC Ref:- NII/08 & 10 RWDTG scope element S19/07	By investigating the use of other materials savings could be made. Save money on purchase of containers, better lifetime, better design.
2.6.4 Magnox Storage Guidance	Guidance on the storage requirements for immobilised wastes has been revised	The NDA Package performance Industry Group has developed further guidance. This project will update the guidance by taking account of the developments and using site and stakeholder buy-in. Guidance will also be developed on the use of dummy packages.	2008/09	>£50k	Need	Generic RWDTG scope element S03/08	
3.2.1 On site	Alternative means for storing LLW need to be identified and	Space at the National LLWR is limited and may not have the capacity to take all the LLW arising from the civil nuclear	2008/09	£100k - £1M	Need / Opportunity	Generic / Site	Following submissions for OSD prepared for HPA <ul style="list-style-type: none"> • TCPA consent application • RSA 93 re authorisation

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
disposal	approved	industry decommissioning programme	TCPA consent application 1 st quarter 2008		Risk: <i>24-24001-07</i> <i>24-24001-19</i> <i>24-24008-20</i>	Addresses NII AoC Ref:- NII/01 Innovative Strategic Project managed by the DSO. Project Ref: 39/39035	Euratom Article 37 submission
<i>3.4.2 Decontamination Techniques</i>	<i>Knowledge of industry best practice decontamination techniques required to select potential tools for optioneering</i>	<i>Available current technologies need to be reviewed when identifying potential solutions to contaminated plant and equipment. Selection of tools need to be robust and underpinned by optioneering including Best Practicable Means assessment.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Generic RWDTG scope element N34/07</i>	<i>This work looks at the safe dismantling and decontamination of non-activated structural components of reactor and chemical plant. It will look to test the feasibility of relevant techniques such as microwave scabbling and the application of high pressure washing design.</i>
<i>3.4.3 Contaminated and Activated Metals</i>	The principal of the baseline technical solution was to safestore significant volumes of metal waste on site until natural radioactive decay enabled the waste to reach exemption level. Currently LLW would be consigned to The National LLWR, but as it is nearing its capacity, alternatives are being sought, that will offer economic and environmental benefits. Segregation, Dismantling, Compaction, Decontamination and Size reduction, are being considered. Following the conclusions of recent BPEO's - Reuse or Recycle principals, there is a significant focus on decontamination where smelting and other processes could offer the potential for significant cost benefits. Smelting (including the development of a UK based smelting plant or the use of existing global facilities) will present significant regulatory and stakeholder engagement challenges. However the potential for up to 90% of steel recycled (either outside or within the nuclear industry) presents a strong opportunity.		<i>Activated metals project deferred</i>	£100k - £1M	Opportunity	NDA issue – Solution has applications nationally Supports NII Ref NII/01; NII/03; NII/05 NII issue - review of EIADR99 regarding the repatriation of secondary waste arisings	CAM workshop BPEO Updated Proposal – Value Proposition/Business case Magnox Position Statement – categorisation of contaminated metals. Logistics Assessment

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
7.0.1 <i>Concrete & Miscellaneous ILW</i>	<p>Concrete Overview:</p> <p>The demolition of primary and secondary site structures will yield substantial quantities of contaminated and activated concrete wastes on each site, the main sources being fuel ponds, concrete pressure vessels and reactor bioshields. Current technical baselines consider these materials in two stages:</p> <p>Care & Maintenance Preparations during which materials are packaged for disposal to the National Low Level Waste Repository.</p> <p>Final Site Clearance during which materials are packaged for disposal to the national repository currently being established by RWMD.</p> <p>The sheer volume of material that may require repository emplacement, the finite nature of repository capacity and the costs associated with the packaging, transportation and disposal of concrete wastes are key drivers for this project. It is estimated that packaging savings of up to £2.5m per reactor could be made through separating contaminated/activated materials from those that can be free released in the circumferential bioshield alone. Moreover, the potential cost implications of having to transport bulk concrete waste as divisible loads are lessened through a reduction in the quantity of materials to be packaged for disposal.</p> <p>Misc. ILW Overview (Now Desiccant and Ionsiv projects)</p> <p>Site waste inventories currently include a number of miscellaneous wastes that generally exist in relatively small volumes. Desiccant and Ionsiv resin wastes specifically require consideration as current technical baselines are not fully underpinned. The project will also consider how any technical solutions could be deployed and will target mobile facilities in line with the relatively low material volumes to be managed at each site.</p> <p>Desiccant and Ionsiv wastes are considered in two separate projects.</p> <p>Desiccant materials are used during the operational period within gas dryers to control the moisture content of reactor gas. During this process, radioactivity (principally tritium) becomes fixed within the desiccant. Desiccant wastes are usually held in their raw form in the dryer vessels or within drums. Historically two types of desiccant materials have been used at Magnox stations: “alumina” and “molecular sieve”. The current baseline strategy for the management of this waste is to immobilise in cement via an in-drum (lost paddle) mixing process for disposal as ILW to the deep geological repository.</p>	<p><i>Concrete element deferred</i></p> <p>Interim Letter of Conformity</p>	<p>£100k - £1M</p> <p>£100k - £1M</p>	<p>Need:</p> <ul style="list-style-type: none"> to understand extent of tritium diffusion through concrete Bioshield, currently a huge uncertainty Opportunity (to reduce Concrete disposal volume & cost) and hence enable Early FSC Opportunity to firm up costs by identifying Orphan wastes and underpinning the disposal route for these Opportunity to reduce risk on IonSiv and Desiccant disposal routes as currently orphan wastes. 	<p>Generic/ND A issue</p> <p>Addresses NII AoC Ref:- NII/02, 03 & 05,</p> <p>Project Ref: 10.39.35.39/39050.43.20</p>	<p>Development of an underpinned management/disposition strategy for concrete, desiccant and Ionsiv resin wastes that will enable the changes to be made to site technical baseline plans and the provision of comprehensive and substantiated options appraisal data to the sites to enable a consistent and informed BPEO process to be carried out.</p>	

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
	Orphan wastes are described by the Nuclear Decommissioning Authority (NDA) as materials for which no 'final' treatment or final disposal route have yet been identified, i.e. there is no underpinned disposal route or agreed transfer established. Desiccant has been identified as an orphan waste. Ionsiv Ionsiv cartridges have been used on 4 stations to reduce Caesium levels in the ponds and reduce the volumes of resins used for pond water treatment. The baseline disposition of the Ionsiv, assumed to be polymer encapsulation has yet to be fully established and there is a potential to challenge this baseline and look at a simpler disposal strategy for sites with lower dose cartridges. The basis of the Ionsiv work is to take forward the concept of macro encapsulation with the NDARWMD (RWMD) to obtain a Conceptual LOC and to address generic Ionsiv issues such as package type, cartridge inventory and criticality assessments. The base assumption has been to polymer encapsulate Ionsiv cartridges into 500 litre ductile cast iron drums which require over packing in a 3m ³ box. The Ionsiv work is to develop macro encapsulation in a cementitious grout matrix and to investigate alternative packaging other than the 500 litre ductile cast iron drum in a 3m ³ , such as the 500 litre stainless steel drum with an annulus shielding grout or several cartridges into a 3m ³ box with pre-cast forms.						
9.5.1 Position statement on design and operational concepts for Magnox ILW stores	Standardise the approach to ILW store design. Central co-ordination and review of work already carried out and dissemination to site as appropriate.	The design and operational concepts for ILW stores should be similar and based on a common database (steel corrosion rates, known environmental conditions, gas-release rates etc). The project will review the use of a standardised store operating conditions and parameters based on existing and proven store designs.	2008/09	>£50k	Opportunity	Generic Addresses NII AoC NII AoC Ref:- NII/07 & 08, RWDTG scope element S06/07	Production of key reports with dissemination of information across UK sites
9.5.3 <i>Reworking and Package longevity</i>	<i>Need to identify the tools and techniques required to monitor and mitigate the aging processes that occur in prolonged storage.</i>	<i>Packages degrade during prolonged storage and may become unacceptable to the ultimate waste repository.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Generic RWDTG scope element N33/08</i>	<i>A techniques document identifying the available tools and techniques available for package inspection, identification of out of specification packages, non compliant packages and there remediation requirements. Should also cover identification and management of high risk packages.</i>
9.5.4 <i>Fault</i>	<i>Knowledge of metal-grout de-bonding mechanism</i>	<i>ILW packages will need to be recovered from the storage vault for through life inspection. During this process the</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Generic</i>	<i>Feasibility report for the use of dummy containers.</i>

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
<i>condition storage and movement</i>		<i>packages need to be maintained in optimal storage conditions to ensure they do not degrade.</i> This project will build on previous work and address whether a dummy container can be made to monitor the impacts during realistic transport and store movements. The significance, if any of metal-grout de-bonding will be investigated.				<i>RWDTG scope element N35/08</i>	<i>Report on the significance of grout – metal debonding.</i>
9.6.1 Application of MAGGAS model to cemented wastes	Research of gas generation rates with respect to store environment from encapsulated cementitious waste forms	Continued modelling of gas generation evolution from waste packages used to underpin RWMD letters of compliance. Also for application at store scale. Training for Magnox staff in its use is expected during FY07/08	2008/09	>£50k	Need	Generic Addresses NII AoC Ref:- NII/06, 07 & 08, RWDTG scope element N12/07	Updated version of the model and gas generation predictions to assist LoC applications.
9.7.2 Long term monitoring of cemented wastes	Grout encapsulated waste is to be kept in long term storage. There is a requirement to determine the effects of ageing on that waste.	To ensure that ageing processes in cemented waste are understood. It is necessary to monitor cement samples in a range of environmental conditions and over a long period of time. Currently some 500 cement samples are being stored in an environmental storage facility at AEAT Winfrith. This work has been ongoing for 12 years. The current plan is to continue the programme of monitoring up to 10 physical properties including strength, dimensional stability and weight at intervals of up to twice a year.	2008/09	£50k - £100k	Need Risk 24-24024-11	Generic NII AoC Ref:- NII/06, 07 & 08, RWDTG scope element 11/07	Regular reports on sample conditions. Any deterioration in sample conditions would require urgent review.
9.7.3 Effect of package movements on corrosion rates	There is evidence which suggests that movement of samples of cemented waste may accelerate drum corrosion. Drums are routinely moved to carry out inspections.	This work is aimed at determining whether there are accelerated corrosion risks associated with the practice of moving drums to carry out inspections. Ongoing work of strategic importance to the company. An instrumented container has been prepared to establish the effect of repeated drum movement and this is being subjected to a programme of controlled movements, to simulate the whole life storage situation.	2008/09	>£50k	Need	Generic NII AoC Ref:- NII/08 RWDTG scope element (N15/07 (completed) S18/07	Entry into care and maintenance will not be permitted without approved safety case, leading to a requirement to retain staff for longer, extending hotel costs. Underpins RWMD LoCs
9.7.4 Corrosion of packaged waste under	The management of the care and maintenance of stainless steel ILW packages needs to be controlled. This is done via a	The guidance document covers the lifetime of the waste containers, from manufacture through to delivery of the packages to the national repository at the end of the interim storage period. It acts as a guidance document for all	2008/09	£50k - £100k	Need	Generic NII AoC Ref:-	Regular reports on sample conditions. Any deterioration in sample conditions would require urgent review. Data to be use in LoC submissions (and revalidation)

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
extended storage	guidance document. Recent information suggests that 500 litre RWMD stainless steel waste drums in EPS1/2 at Sellafield may not have an adequate lifespan.	technical aspects of the processes involved with production, waste filling, transportation and eventual storage of ILW packages. Maintenance of the document is an ongoing process. Ongoing work involving responding to technical issue and updating the guidance document as required.				NII/06, 07 & 08, RWDTG scope element 13/07	
<i>12.1.2 Long term integrity of building cladding panels.</i>	<i>The integrity of cladding surrounding decommissioned reactor buildings is of long term concern.</i>	<i>It is necessary to understand the life span of the cladding covering decommissioned (safestore) reactor buildings to ensure that cladding is replaced at appropriate intervals. This programme is aimed at determining what that interval is likely to be. This is an ongoing programme of work involving annual inspection of panels at the Dungeness A Cladding Exposure Facility.</i>	<i>2008/09</i>	<i>>£50k</i>	<i>Need</i>	<i>Generic RWDTG scope element N21/08</i>	<i>Selection of most appropriate material and better prediction of the maintenance requirements for cladding panels during Care and Maintenance. Continue scope of detailed annual examination with photographs and report on the 20 samples of cladding mounted on frames at Dungeness.</i>

Table 3A: Magnox Electric Ltd. Waste and Decommissioning Research and Development Programme (Work that is on-hold for FY 2008-09)

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Needs / Risks / Opportunity	Site / Generic / NDA issue / NII Area of Concern reference	Key outputs / Actions
11.0.1 Back to Bioshield	This project will co-ordinate the development and placement of a contract to implement the reactor decommissioning (Back to Bioshield) scope of work in a co-ordinated manner across the involved sites. It will also support the attainment of the necessary regulatory approvals required to allow implementation of the revised scope of work for the C&M preps phase which now includes the early removal of the boilers, blowers and ducts (primary gas circuits components). This acceleration potential, enabled by recent characterisation studies, provides possibilities for life-time cost savings through the C&M phase. Additionally there are benefits of improved visual perception through building size reduction in earlier stages of decommissioning.		<i>Project Deferred</i>	£100k - £1M	Opportunity	Generic/ND A issue Addresses NII AoC Project Ref: 10.39.20.39/39010	Development of an NDA and NII document and strategy review to progress through Gate 1. Issue an Invitation to Tender (ITT) to the supply chain to carry out the work
14.0.1 Final Site Clearance	In line with the NDA aspiration of early (25Year) site clearance set out in the NDA strategy 2006, Magnox South has developed a project to assess the potential for accelerated FSC. The aim of the work is to examine the possibility of driving to site clearance and re-use to the benefit of the tax payer and local communities. The project will co-ordinate development of a business case to examine the financial (cost benefit) and non-financial benefits (socio-economic, intergenerational equity) of accelerated site clearance compared to existing baselines of deferred site clearance. It will re-assess all feasible, practical options for site clearance at a high level to ensure robustness of previous work in this area and will produce data to support the overall business case. Throughout the work Magnox South will engage with key stakeholders and regulators to ensure that any proposals are broadly acceptable and consider all relevant scenarios and views.		<i>Project Deferred</i>	£100k - £1M	Opportunity	Generic/ND A issue Addresses NII AoC Project Ref: 10.39.20.39/39015	Trial use of bulk assay system. Pilot disposal of VLLW to a commercial facility.
14.0.2 Alternative Disposal Options	In conjunction with examination of alternative Final Site Clearance opportunities, Magnox South proposes to examine innovative, alternative disposal solutions across the globe. Waste management and disposal of Intermediate Level Wastes in the UK is an extremely challenging issue facing the nuclear industry. There is currently no ILW disposal facility in the UK, and potentially may not be until 2040 which is the baseline date for RWMD availability within the site Lifetime Plans. Magnox South is striving to identify and develop significant opportunities for innovative ILW disposal methods, both within, and outside of the UK. Magnox South will highlight any barriers to such potential solutions, and outline future work to address them. The work will address on-site, in-situ options such as mounding/burial and sinking, in conjunction with more radical ideas at existing disposal sites overseas to ensure value for money to the NDA and UK tax payer.		<i>Project Deferred</i>	£100k - £1M	Opportunity	Generic/ND A issue Addresses NII AoC Project Ref: 10.39.35.39/39050	Development of alternative graphite management strategy – expected to be underpinned by “small” scale trial of a preferred graphite “destruction” technology with a view to providing further data to enable a final decision re destruction Vs burial
14.4.1 Graphite Disposition	Decommissioning the Magnox fleet will result in the need to dispose of tonnes of mainly ILW irradiated graphite. The current baseline is to encapsulate for deep geological disposal. The aim of the project is examine alternative disposal routes taking account of environmental impact, costs and schedule performance. Improved solutions may be achieved through volume reduction, reducing the radionuclide content of the graphite or justification of shallow disposal. Reduction of the amount of ILW for geological disposal is expected to be an enabler for early final site clearance.		<i>Project Deferred</i>	£100k - £1M	Opportunity	Generic/ND A issue Addresses NII AoC Project Ref: 10.39.35.39/39050.43.35	Development of alternative graphite management strategy – expected to be underpinned by “small” scale trial of a preferred graphite “destruction” technology with a view to providing further data to enable a final decision re destruction Vs burial

Table 3B: Magnox Electric Ltd. Waste and Decommissioning Research and Development Programme (Work that has been completed or deleted)

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
1.3.4 Grout enclosure techniques.	A requirement has been identified for the need to develop a sealed inner container grout and characterisation techniques identified to condition tritium containing desiccant. Suitable grouts will be identified for a grout-enclosed concept and verify radiolysis would not lead to pressurisation of an inner container.	ILW Stores are designed to be “clean” the intent being that they would not have a discharge authorisation during their operational storage phase. Tritium being released during the storage period may require an discharge authorisation to be sought	2008/09	>£50k	Additional R&D work identified to investigate containment of potential tritium discharges.	Feasibility report.
1.3.5 Handbook for the processing and immobilisation of desiccant waste	Knowledge management – capture of current knowledge and understanding regarding process and immobilisation requirements for the future.	Deferring decommissioning activities requires more staff to become familiar with the concept and processes for immobilising desiccant wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future.	2008/09	>£50k	Generic R&D captured in HPA TBRD	Key database – Handbook of the processing and immobilisation of desiccant waste.
1.5.3 Benefit of radioactive sludge cementation	Assess the feasibility, cost and benefit of cementation trials on Magnox station radioactive sludge	This project will assess the implications and possible benefits from the use of real active waste samples as part of the routine demonstration of waste package integrity as part of the RWMD LoC process. This project will produce a generic specification for active waste trials with encapsulated material should their use be required in the future.	2007/08	>£50k	Package of work on target for completion by March 2008.	Report with developed Magnox position on the implications from active trials (e.g. safety, environment, cost and technical) and a preliminary approach to implement, as appropriate.
1.5.4 Long term integrity of Lewatit in cement.	Investigate the stability of Lewatit DN resin in a cementitious grout with Silica Fume	Lewatit DN will swell when encapsulated in a cement matrix. Further formulation trials are required to underpin a grout formulation and process to encapsulate Lewatit resin	2007/08	£50 – £100k	Package of work on target for completion by March 2008.	Stable cement formulation for the encapsulation of Lewatit DN IX resin.
1.5.5 Review of waste sludge properties and processing	Support of the NDA in their aspiration for wider supply chain engagement in identifying opportunities for R&D addressing risks and gaps from TBRD’s.	The project will collate information on sludges and approaches currently used by stations including the needs for mixing of sludges and IX resins for economical grouting of Lewatit. Approaches used by other industries will be reviewed.	2007/08	>£50k	Package of work on target for completion by March 2008.	Workshop and post-workshop support is consistent with NDA aspirations, e.g. encourages participation by the supply chain and collaborative working to mitigate future risks/realise future opportunities.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
1.5.9 ILW Transportation. <small>39/39052</small>	Optimise new build solidification plant by transferring ILW to designated lead process site <i>Project Ongoing</i>	At present each site needs to engineer its own arrangements for ILW process and encapsulation plant even where only small quantities of waste need to be processed and suitable plants are available at other sites	Stage 1 Raw waste transport containers. FY 2007/08	£100k - £1M	Stage 1 report on target for completion by March 2008 Stage 2 & 3 scope identified.	Stage 1 – Report on selection of Raw Waste Transfer containers. <i>Complete</i>
Task 1.8.2 Radiochemical analysis	Assess technical capability of the radiochemical characterisation industry to meet the demands placed on it by the UK civil nuclear decommissioning.	Inability to process samples will lead to delays in the development of design solutions and / or the processing of waste. Creating additional capacity takes time since resources need to be trained and facilities licensing.	2008/09	>£50k	Addition R&D scope to assess the current capacity of the radiochemical analysis business to support UK civil nuclear decommissioning.	Radiochemical analysis capability report
2.3.2 Deposition of WRATS and suspected orphans	Identification of routes and means for immobilisation of minor waste streams	Small volume waste streams have been identified and the project will determine if they are orphan wastes and investigate the best practice for management and / or waste disposal. Includes wastes such as zinc bromide, tank / silo residues, Zeolite, skips etc.	2008/09	>£50k	Additional R&D identified to reduce the risk that an “Orphan” waste is subsequently found.	Best practice report
2.4.3 Security of materials supply	Investigate securing the supply of materials essential for waste remediation.	Supply of materials is subject to market forces demand from the developing world for steel has driven steel prices up over last few years. Similar problems may be experienced obtaining cement powders and Blast Furnace Slag of an appropriate quality.	2007/08	£20k	Package of work on target for completion by March 2008.	Supply security strategy.
2.4.8 Contaminated Gravel Treatment	To reduce the volume of material requiring encapsulation and management as ILW.	Gravel is used in the dry FED vaults as a buffer between the waste and the concrete structure designed to keep the FED out of any water lying at the bottom of the vault. As such the gravel will be contaminated but will not have been activated. Depending on the type of gravel used in the vaults it may be possible to decontaminate it below the ILW threshold saving a potential 10, 3m ³ boxes of ILW.	2008/09	>£50k	Additional R&D work identified to reduce potential volume of ILW resulting from encapsulation of contaminated vault gravel inventory as ILW material.	Feasibility study.
2.4.9 Security of materials supply	Investigate securing the supply of materials essential for waste remediation.	Supply of materials is subject to market forces demand from the developing world for steel has driven steel prices up over last few years. Similar problems may be experienced obtaining cement powders and Blast Furnace Slag of an appropriate quality.	2008/09	>£50k	Ongoing strategic review of materials to support solidification of ILW.	Supply security strategy.
2.4.10 Use of Comb Superplasticisers	The ability to use superplasticisers in cementitious grouts may enable the use of compaction conditioning of FED materials to improve packing density prior to cementation.	The use of organic superplasticisers does not satisfy the RWMD packaging requirements. An alternative superplasticiser material has been identified and work was undertaken last year to irradiate the samples under W&D R&D scope element N14/07. This work is being assessed by RWMD who will provide their findings in FY 08/09. Delay to this may foreclose the use of superplasticisers in the design of waste process/packaging plants if favourable advice is not received during FY 08/09.	2008/09	>£50k	Further R&D into the use of superplasticisers in cementitious grout formulations.	Analysis of decay products and determination of the future use of comb superplasticisers.
2.4.11	Knowledge management –	Deferring decommissioning activities requires more staff to	2008/09	>£50k	Generic R&D captured in HPA	Key database - Handbook of the processing

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
Handbook for the processing and encapsulation of Magnox FED.	capture of current knowledge and understanding regarding process and encapsulation requirements for the future. Knowledge management – capture of current knowledge and understanding regarding process and encapsulation requirements for the future.	become familiar with the concept and processes for solidifying FED wastes. Information needs to be compiled to ensure a body of knowledge is maintained for the future. Knowledge management – capture of current knowledge and understanding regarding process and encapsulation requirements for the future.			TBRD	and immobilisation of Magnox Fuel Element Debris (FED)
2.6.2 Optimisation of design, procurement and use of RWMD ILW containers	Need to identify the optimal solution for providing a satisfactory quality of waste box to all sites within the group	Since most sites will operate waste plants solidifying ILW over a common period the business needs to ensure that the supply chain is engaged to provide a suitable quality of box at a rate which is capable of satisfying the demand from each site	2007/08	£50 - £100k	Package of work on target for completion by March 2008.	Technically focused contribution to an integrated and optimised strategy across the Magnox fleet for the design, procurement and use of ILW containers which is consistent with the RWMD disposal concept and the context under which the Magnox Sites operate.
3.2.2 Particulate science of magnesium hydroxide based materials in support of Magnox wet waste processing.	No change	No change	No change	No change	R&D Task ID 3.2.2 re-identified as 1.5.25 to align with the technical baseline task to which it relates.	No change
3.4.1 Metal melting	Investigate feasibility of using metal melting to recycle contaminated metals.	Large volumes of metals are currently sentenced as contaminated/activated LLW. This material takes valuable repository space which could be released if better decontamination techniques could be deployed to enable metals to be recycled.	March '08	£100k - £1M	R&D completed and BPEO report prepared. Recycling of metals for beneficial reuse replaces sentencing of waste for disposal in the National LLWR.	BPEO report HINA/R/W/005 – Metal melt and chemical decontamination trials report. The HPA Technical Baseline in table 1 has been revised to identify metal melting and reuse by the nuclear industry in the US as being the sites baseline solution for contaminated pond skips..
3.4.2 Decontamination Techniques	Knowledge of industry best practice decontamination techniques required to select potential tools for optioneering	Available current technologies need to be reviewed when identifying potential solutions to contaminated plant and equipment. Selection of tools need to be robust and underpinned by optioneering including Best Practicable Means assessment.	2008/09	>£50k	Generic R&D captured in HPA TBRD	This work looks at the safe dismantling and decontamination of non-activated structural components of reactor and chemical plant. It will look to test the feasibility of relevant techniques such as microwave scabbling and the application of high pressure washing design.
3.4.3 Contaminated and Activated	Unchanged	Unchanged	Unchanged	Unchanged	Was originally Task ID 4.4.1 – renumbered to reflect correct allocation of work activity.	Unchanged

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
Metals						
4.4.1 Contaminated and Activated Metals	Unchanged	Unchanged	Unchanged	Unchanged	Task renumbered Task ID 3.4.3 to reflect correct allocation work activity.	Unchanged
7.1.1 Review of Chemically Hazardous Wastes arising from decommissioning	Need to accurately quantify chemically hazardous waste arising from decommissioning leads to a shortfall in NDA provisions (e.g. PCBs, asbestos, lead, heavy metals)	The project will review and catalogue all waste arisings from the decommissioning of a “generic” Magnox reactor defined to represent all features of the current fleet. The waste types will be reviewed with reference to industry codes of practice and regulations to produce a hazard register which will highlight potential problems not previously recognised. As radioactive waste streams will be characterised, most effort will be on conventional waste and radioactively contaminated building materials and plant.	2007/08	>£50K	Package of work on target for completion by March 2008.	Key reports summarising current position.
9.5.2 Development of a Specification and Strategy to Deploy Dummy ILW Packages in Support of the Long-term Storage Safety Case	Care and Maintenance safety cases are not approved owing to the absence of a company standard for waste package monitoring specification	Review of a specification and strategy to deploy dummy ILW containers and coupons. The monitoring results will underpin safety case for long-term storage and revalidation of LoCs.	2007/08	>£50k	Package of work on target for completion by March 2008.	Developed specification for application across Magnox sites.
9.5.3 Reworking and Package longevity	Need to identify the tools and techniques required to monitor and mitigate the aging processes that occur in prolonged storage.	Packages degrade during prolonged storage and may become unacceptable to the ultimate waste repository.	2008/09	>£50k	Additional R&D to support package storage.	A techniques document identifying the available tools and techniques available for package inspection, identification of out of specification packages, non compliant packages and their remediation requirements. Should also cover identification and management of high risk packages.
9.5.4 Fault condition storage and movement	Knowledge of metal-grout debonding mechanism	ILW packages will need to be recovered from the storage vault for through life inspection. During this process the packages need to be maintained in optimal storage conditions to ensure they do not degrade. This project will build on previous work and address whether a dummy container can be made to monitor the impacts during realistic transport and store movements. The significance, if any of metal-grout de-bonding will be	2008/09	>£50k	Further R&D into the affect of package movement on grout – metal bonding and its significance.	Feasibility report for the use of dummy containers. Report on the significance of grout – metal debonding.

Task ID	Technical need - task + gap	Context of why a problem	Target Date	Cost range	Identification of change	Key outputs / Impact of change
		investigated.				
9.7.3 Effect of package movements on corrosion rates	There is evidence which suggests that movement of samples of cemented waste may accelerate drum corrosion. Drums are routinely moved to carry out inspections.	This work is aimed at determining whether there are accelerated corrosion risks associated with the practice of moving drums to carry out inspections. Ongoing work of strategic importance to the company. An instrumented container has been prepared to establish the effect of repeated drum movement and this is being subjected to a programme of controlled movements, to simulate the whole life storage situation.	2007/08	£50k - £100k	Package of work on target for completion by March 2008.	Data to be used to support LoC submissions (and revalidation).
12.1.1 Long term integrity of cladding	The integrity of cladding surrounding decommissioned reactor buildings is of long term concern.	It is necessary to understand the life span of the cladding covering decommissioned (safestore) reactor buildings to ensure that cladding is replaced at appropriate intervals. This programme is aimed at determining what that interval is likely to be. This is an ongoing programme of work involving annual inspection of panels at the Dungeness A Cladding Exposure Facility.	2007/08	£50k - £100k	Package of work on target for completion by March 2008.	Selection of most appropriate material and better prediction of the maintenance requirements for cladding panels during Care and Maintenance.
12.1.2 Long term integrity of building cladding panels.	The integrity of cladding surrounding decommissioned reactor buildings is of long term concern.	It is necessary to understand the life span of the cladding covering decommissioned (safestore) reactor buildings to ensure that cladding is replaced at appropriate intervals. This programme is aimed at determining what that interval is likely to be. This is an ongoing programme of work involving annual inspection of panels at the Dungeness A Cladding Exposure Facility.	2008/09	>£50k	Ongoing strategic review of cladding materials to support care and maintenance safety cases and costings.	Selection of most appropriate material and better prediction of the maintenance requirements for cladding panels during Care and Maintenance. Continue scope of detailed annual examination with photographs and report on the 20 samples of cladding mounted on frames at Dungeness.