Magnox South

Technical Baseline And Research & Development Document For Berkeley Nuclear Licensed Site

Lifetime Plan 2008/09

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TITLE: Technical Baseline and Research & Development Document for Berkeley Nuclear Licensed Site, Lifetime Plan 2008/2009.

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Revision Register

Revision Ref	Date	Author	Reason
		N Roynon	LTP 08/09
	13 November 2007	J Gardner	Addition of generic information
	3 January 2008	J Gardner	Incorporating Site comments
	22 January 2008	N Roynon	Incorporating relevant NDA comments & new site strategy

Contents

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1. Introduction

This section of the Lifetime Plan (LTP) submission, the Technical Baseline and Research and Development (TBRD) document, provides an overview of the Berkeley Nuclear Licensed Site (BNLS) technical baseline and research and development work that supports the approach to decommissioning for the remainder of the site's lifecycle.

BNLS is part of Magnox South reactor sites and is currently engaged in decommissioning and cleanup activities. The three remaining phases of the site's lifecycle are described in this TBRD document and are listed below:

- Defuelling – completed at BNLS
- 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 license that includes BNLS, is responsible for developing and implementing decommissioning and waste management strategies consistent with the requirements and overall national strategy of the Nuclear Decommissioning Authority (NDA) (Ref 1) and in accordance with relevant Government policies.

This TBRD document represents the BNLS, site-specific implementation of the current strategy agreed by Magnox Electric Ltd Board for the Magnox business. Work will also be carried out with the Decommissioning Strategy Organisation (DSO) that 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 strategies to be implemented at BNLS.

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 BNLS:

- 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, 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 values and the future reduction of these carried out in line with the NDA prioritisation process.
- 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.
- 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 BNLS has 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 de-license the site or to achieve other such end state as agreed.

BNLS 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) (Ref 3) in 2000. The QQR submission was updated in 2005 to a Company Standard (Ref 5) agreed by the Magnox Electric Board in 2005. It was revised and re-issued in March 2007 and is subject to periodic review and update.

It is recognised that the BNLS 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

BNLS is currently in the phase of site decommissioning known as Care and Maintenance Preparations (C&M Preps), whereby all buildings with the exception of the two reactor buildings and the Intermediate Level Waste (ILW) Store, will be demolished. At the end of this phase the Site will enter the long term passively safe state known as the Care & Maintenance (C&M) phase.

The scheduled date for completion of C&M Preps was December 2011. However, in line with NDA works prioritisation and subsequent funding cuts at BNLS, the main decommissioning projects have been deferred. As a consequence, the next BNLS Periodic Safety Review will justify the current radioactive waste streams continuing to be safely stored on site; without being retrieved and passivated. The Periodic Safety Review is due to be submitted to the NII in August 2008, for agreement by August 2009, to continue safe and secure site operations until 2019.

The BNLS layout consists of three primary areas of decommissioning work:

- Conventional area – containing non-radioactive plant and buildings (workshops and offices etc.).
- Radiological Controlled Areas (RCA) – including a number of buildings with internal plant and structures that are contaminated with radioactive substances (e.g. operational waste storage facilities, shielded facilities, active laboratories, radioactive effluent treatment plant, active drains, 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 its mortuary holes. This is provided for interim storage of packaged ILW until the national repository is available.

This document expands on the 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. BNLS 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, and Intelligent Customer capability is fully 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 bio-shield in the two reactor buildings and a newly constructed Intermediate Level Waste (ILW) store will be removed from site. The planned work for this phase includes the following:

- The encapsulation of retrieved operational ILW and placement in an on-site store pending the availability of an off-site repository or alternative facility.
- An operational fire suppression system during preparations for the retrieval of material from the dry vaults and the actual retrieval process itself.
- 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 maintained in a lay-down state until disposal path options are established.
- The deplanting and demolition of the buildings within the non-reactor/conventional area of the site (note that buildings within the Berkeley Centre footprint will be managed by Magnox South not BNLS).
- Implementation of a management strategy for any contaminated ground.
- Safe store 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 and secure and installing 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 will 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.

An indication of the main activities and process flows during the C&M Preps phase is provided in Figure 1.

1.2.2. C&M Phase

Following the period of C&M Preps, BNLS 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 allows the radioactivity on site to decay and allows radiological benefits to be accrued from the deferral of the final dismantling activities. Throughout the C&M phase, manned sites, surveillance and security, radiological and environmental monitoring and programmed inspection and maintenance of the buildings remaining on site is provided for. The C&M period at the site is currently planned to continue to 2074.

For planning purposes only, it is assumed that a 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. The on-site ILW store, once emptied, will remain in-situ until the FSC phase when it will be cleaned, decommissioned and demolished.

The main activities undertaken during the C&M period will be to maintain 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 BNLS 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 transition period at the end of the C&M Preps phase. 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 the Berkeley Site will remain a nuclear licensed site, subject to nuclear licence conditions and independent regulatory scrutiny, to ensure that safety, environmental and security standards remain high.

An indication of the main activities and process flows during the C&M phase is provided in Figure 2.

1.2.3. FSC Phase

Following the C&M phase the site will enter the Final Site Clearance (FSC) phase and begin full dismantling and remediation that will result in the site being delicensed and available for future. 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 fit for future re-use. This includes the complete removal of the remaining buildings on the site, i.e. the reactor bio-shield and reactor components. In order to progress this work it will be necessary to install new site infrastructure facilities, e.g. offices, workshops, waste treatment plants, etc.

The technical baseline is based around the current schedule to commence FSC in 2074 with completion in 2083. BNLS began to assess options that would allow for acceleration of FSC activities.

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.

- 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 LLW repository 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, a 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 de-licensing.

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

1.4. Key Site Assumptions

The key assumptions for the BNLS include:

New construction projects:
- Solid ILW waste will be containerised and stored in compliant waste boxes and drums in the ILW store.
- The Reactor buildings will require re-cladding at 30 year period intervals.

Waste & Nuclear Materials Management:

- The National ILW Repository will be available from 2040, and will be able to accept BNLS's packaged ILW between 2046 and 2049.

Decommissioning & Termination:
- The boilers will remain in situ until final site clearance.

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

1.5. Risk Management Overview

BNLS processes and policies with respect to Risk Management ensure compliance with NDA procedure PCP10. 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 BNLS decommissioning programme.

The BNLS 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.

- 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 are 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 BNLS 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.

- Design of ILW Store piled foundation to address the soft ground conditions.
- Testing and demonstration of prototype vault retrieval machines, with resulting selection of Qualter Hall option, incorporating Brokk retrieval method, for AWVR.
- Removal of final monitoring and delay tanks using manual cold cutting techniques (CRP Project).
- Identification of formula for maximising CRP sludge/resin volumes in package and 90 day monitoring of cemented simulant. Initiated 360 day irradiation trials to demonstrate its acceptability for ultimate disposal.
- Removal of aloxite by hydraulic means from CRP sand pressure filter vessels. Dessicant formulation 90 day test results proved suitable for compliant LOC submission.

3. Good Practice

In the past year BNLS 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 BNLS, this includes the following:

- Communicating with other sites to ensure commonality of design in, for example, ILW store; and to share good practice, for example, in disposal of aloxite (see below).
- De-watering of aloxite and pond sludge from the CRP for disposal as LLW direct into HHISO containers without the need to encapsulate in 200 litre drums; resulting in a significant reduction in waste volume to the UK LLWR.
- Sludge in base of final monitoring and delay tanks pumped, using diaphragm pump, to settling tank, instead of immediate encapsulation. This enables a rationalised approach to encapsulation.

4. Technical Baseline

The Technical Baseline Table for BNLS 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.

The tables also provide BNLSs' 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.

In some cases however site specific opportunity development work is being carried out even though the TRL for that work package is at 9. This also supports continual improvement in BNLS 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. This will be incorporated into the developing lifetime plans supporting risk reduction and efficiencies in delivery of work.

The tables 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.

5. Research & Development (R&D)

The BNLS 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 BNLS in support of acceleration and/or further optimisation of the Baseline (opportunities).

The tables set out the technical need, explaining what has to be done and why, putting the technology gap into context. The table provides the key outputs expected from the R&D proposals and sets out, at high level, how these outputs will be used. In addition, the tables present the date when the solution should be in place to allow successful action on the Lifetime Plan (which must, of course, 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

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 "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 BNLS technical baseline and R&D programme by developing the TRL and the mitigation of technical risks is referenced in the R&D table. More detailed information is contained in the R&D table of the Magnox Electric Limited Waste and Decommissioning Research & Development Programme document.

6. References

1	NDA Strategy 2006
2	Managing the Nuclear Legacy: A Strategy for action (Cm 5552)
3	Magnox Electric plc Quinquennial Review of Decommissioning and Waste Management Strategies, April 2000
4	A Review by HM Nuclear Installations Inspectorate: Magnox Electric plc's strategy for decommissioning its nuclear licensed sites, February 2002
5	Magnox Electric's Decommissioning and Waste Management Strategy: ME/S/036, 2005
6	Revised Reactor Decommissioning and Waste Management Objectives and Principles Magnox Executive Team Meeting Paper: ET 701, April 2003.
7	Arrangements for the development of Waste Management and Decommissioning Strategies for Magnox reactor sites: LS/MI/004, 2005
8	Principles and guidance for safe decabling and electrical deplanting during reactor decommissionir RDU/SAB/G/001, 2000
9	Project strategy overview report for the electrical overlay system project: HINA/PSOR/9125
10	Decommissioning of Liquid Waste Storage Tanks on Magnox Reactor Sites – Consideration of End-points for Care and Maintenance Preparations: BNFL.ENVT.SERVS/ET/REP/GEN/0813/03, June 2004
11	Decommissioning of Solid Waste Storage Vaults on Magnox Reactor Sites - Consideration of End-points for Care and Maintenance Preparations: BNFL.ENVT.SERVS/ET/REP/GEN/0812/03, 2004
12	Care & Maintenance Preparations for Magnox Reactor Sites: Recommendations for the decommissioning of underground structures and Services: BNFL.ENVT.SERVS/ET/REP/GEN/0960/04, 2004
13	Best Practicable Environmental for management of Ion Exchange Material at Bradwell, Dungeness 'A', Hinkley Point 'A' and Oldbury 'A': M/TE/MAG/0056/98, 1998
14	Best Practicable Environmental for Management of ILW Sludge stored on Operating Magnox Power Stations: TE/GEN/REP/0010/98, 1998
15	A Review of Wet ILW Management on Reactor Sites: REM(S)034, 2005
16	Review of mobile plant for wet and solid ILW and recommendations to support decommissioning: ES/ET/REP/0261, 2002
17	Wet ILW dewatering and encapsulation plant: ES/ET/REP/TRA/0458/02, 2004
18	Strategy for the Management of Fuel Element Debris at Bradwell, Hinkley Point 'A', Oldbury and Sizewell 'A' Power Stations: RDU/S&A/GEN/REP/0037/00, 2000
19	Bradwell Power Station Radioactive Waste Management Strategy: BRAD/TH/REP/139, 1995.
20	Hinkley Point A Power Station Radioactive Waste Management Strategy: HPA/TECH/HP/14, 1995.
21	Best Practicable Environmental Option for Management of Miscellaneous Activated Components stored on Operating Magnox Power Stations: RDU/S&A/GEN/REP/0007/99,1999
22	BPEO for management of ILW desiccant stored at Magnox power stations: M/TE/MAG/REP/007/99,1999
23	Hinkley Point A Power Station: Strategy for Identification, Characterisation and Management of

	Contaminated Ground: DPU/REP/HPA/0001/03, 2003
24	Reactor Building Safe store, Technical Guidance Document RS/LSPM/GEN/REP/0182/05 December 2005
25	Proposals for remote monitoring of Decommissioning Magnox Sites during the Care and Maintenance Period: M/RS/GEN/REP/0030/03, 2003
25	Best Practicable Environmental Option for Decommissioning of Magnox Power Stations: M/TE/GEN/REP/0055/98, 1998
26	Nuclear Derivation of the Radiological Impact Parameters used in the Best Practicable Environmental Option Review for Decommissioning of Magnox Power Stations: RDU/S&A/GEN/REP/0006/99, 1999
27	Generic Specification for entry into Care & Maintenance RS/E&TS/GEN/REP/066/05 January 2006
28	Review of Mobile Plant for Wet & Solid ILW & Recommendations to Support Decommissioning ES/ET/REP/0261 Apr 2002
29	Review of BNFL Inc report on Wet ILW Retrieval & Disposal NDCU/E&T/EAN/MAG/0080/1
30	Wet ILW Dewatering & Encapsulation Plant ES/ET/REP/TRA/0458/02 Apr 2004
31	CDDC Decontamination Manual for Berkeley Power Station Ponds Decommissioning DECOM/06/01 Dec 2001
32	Report of Cooling Ponds Clean-up & Demolition BK/ED/191, 2003
33	Berkeley Power Station Decommissioning Experience BK/RD/69
34	Berkeley Power Station Decommissioning 1988 to 1993 GEN/93/001
35	Berkeley Lifetime Plan – Integrated Waste Strategy - BNLS/REP/EH/0006/06

7. Appendices

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
	Level 4	Component and/or bench validation in laboratory environment
Technology Demonstration	Level 5	Component and/or bench validation in relevant environment
System/Subsystem Development	Level 6	System/subsystem model or prototype demonstration in relevant environment
	Level 7	System prototype demonstration in an operational environment
System Test & Operation	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: Berkeley Nuclear Licensed Site - Technical Baseline: Work progressing in FY 2008-09

Task ID (CRP) (PSWBS REF)	Task/Process description	Preceding Task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
1)	**Active Waste Vaults Retrieval (AWVR)**	**On-hold – see Table 1A**						
2)	**Caesium Removal Plant (CRP)**	**Overview:** The CRP contains the following waste forms: Mobile ILW - Sand and sludge from pond water filtration (10.5 m3)/ Spent Ion Exchange resin from pond water treatment (12.4m3)/ Gas drier desiccant in drums (10.6m3). Solid ILW – Miscellaneous Contaminated Items (MCI) from de-planting (5.4m3) Mobil LLW – Pond Sludge & debris from pond wall decontamination (4.5 m3) / Aloxite from Sand pressure filters (8m3) The project is currently at stage 2 - cleaning out and de-planting redundant equipment to provide space for the process plant to be installed to process the waste during stage 3. Stage 3 involves the design, procurement, construction, commissioning, operation and ultimate decommissioning of plant and equipment to process the ILW, package in waste approved containers and transport to the on-site interim store.						
Tasks 2.1 – 2.3 & 2.5	**On-hold – see Table 1A**							
Task 2.4	**Completed – see Table 1B**							
Task 2.6 Solid LLW Processing 1.1.5.21.14.43.21225. 34100.20061)	Disposal to LLWR of waste metal, concrete and general scrap from decommissioning of CRP as work progresses.	CRP Stage 2 works	All contaminated material once shown to be within the LLW classification will be packed into third and/or half height ISO containers as appropriate for despatch to the LLW repository.	9	The CRP will be de-planted using conventional cold cutting techniques			CRP Technical Strategy Document 21/04044/REP/0011/ 1

Task ID (Shielded Area) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
3)	**Shielded Area**	**Overview:** The Shielded Area provided a research facility to examine fuel and irradiated components delivered from Magnox and AGR power stations. It consists of Cells, Caves, active specimen transfer conveyor system, pond , AETP and laundry. Dismantling of the Cells is in progress. The caves contain cans of ILW (14.3m3) and ILW (35.8m3) from Shielded Area decommissioning that will be transferred in shielded containers to a buffer store to wait for the AWVR waste process to be commissioned, thus allowing the decommissioning of the caves to continue. The AWVR waste process will package this waste in compliant approved containers and they will then be transported to the on-site interim ILW store. In 2008/09, it is planned to use the facilites for legacy waste disposal to consign decommissioned items.						
Tasks 3.01,3.4-3.10	**On-hold –see Table 1A**							
Tasks 3.2 & 3.3	**Completed – See Table 1B**							

Task ID (RCA) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
4)	**Radiological Controlled Area (RCA) De-plant and Demolition**	**Overview:** This includes the Active Effluent Treatment Plant (AETP) , LLW Process building and RCA access building. The Active Waste Vaults and the CRP are identified on other tables						
Task 4.1 (1.1.5.21.13.34.21235. 35200.20040)	There are a number of facilities within the RCA that will not be required during the C&M phase. These areas will be de-planted and demolished during the C&M Preps phase	Tasks 1 to Task 7	Radiological & other hazard characterisation will be undertaken. Isolations will be made as appropriate. Radiological, chemical and industrial hazards will be removed to enable subsequent de-planting and demolition of the facilities. Contaminated and non-contaminated asbestos will be removed. Radiological decontamination will be undertaken where required to	9	Conventional demolition techniques will be utilised wherever possible under control & supervision appropriate to contaminated environments			LCBL Detail Volume, Final Decommissioning of Miscellaneous Active Plant/Buildings

Task ID (RCA) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
			assist in subsequent de-plant, demolition and disposal.					
Task 4.2 Install Mobile AETP (1.1.1.21.13.21.21210)	Modular Active Effluent Treatment Plant (AETP) to replace those in BPS and BC.	Business strategy gate 1 delivered December 07.	Develop BPM document for AETP, review options and develop preferred design.	8	Existing technology to be utilised and engineered to meet the needs of BNLS.	Linking into existing active effluent system outlets and to discharge lines on site.	R&D 4.2	
Task 4.3 BPS AETP Oily Sludge (1.1.5.21.14.43.21035. 21180)	Disposal of 37 drums of oily sludge legacy waste from the BPS AETP		These sludges have previously been encapsulation on this site. However, we are in the process of inspecting these drums to see the condition of the waste, in order to find other methods of didposal, eg drying followed by incineration.	8	Use of existing technologies, eg drying equipment	It is necessary to underpin potential disposal methods in order to establish suitability for use.	R&D 4.3	

Task ID (Conventional) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
5)	**Conventional Plant Area De-plant and Demolition**	On-hold – see Table 1A						

Task ID (ILW Store) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
6)	**ILW Store**	On-hold – see Table 1A						

Task ID (Partial Site De-licensing) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
7)	**Partial Site Delicensing**	Completed – see Table 1B						

Task ID (Contaminated Land)) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
8)	**Contaminated Land**	On-hold – see Table 1A						

Task ID (Safe Store Preps) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
9)	**Safe Store Preparations**	On-hold – see Table 1A						

Task ID (FSC) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
10)	**Final Site Clearance (FSC)**	On-hold – see Table 1A						

Table 1A: BNLS, Technical Baseline: Works on–hold during FY 2008-09

Note: Project data will be stored and / or archived in accordance with BNLS MCP3: Document Management and the Gate 5 Project Management procedures.

Task ID (AWVR) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
1)	**Active Waste Vaults Retrieval (AWVR)**	**Overview:** The Active Waste Vault Retrieval project involves the design, procurement, construction, commissioning, operation and ultimate decommissioning of plant and equipment to retrieve ILW from four vaults, package into compliant waste approved containers and transport to the on-site interim ILW store. In addition the AWVR project will process ILW imported from the Shielded Area (E23) and the Ceasium Removal Plant (CRP) to also package into waste containers. The vaults contain Fuel Element Debris (FED) , MiscellaneousContaminated Items(MCI), Miscellaneous Activated Components(MAC), Ion Exchange Resin, Celite, Sludges and gravel.							
Task 1.1 Vault Waste Retrieval (1.1.5.21.14.41.21225. 34200.20052)	Waste collected by the WRM will be recovered to the Retrieval Tunnel where it will be placed onto a heavy fabricated sort tray	AWVR Civil Construction	Waste will be retrieved from each of the vaults using a dedicated Waste Retrieval Manipulator (WRM).	7	Each WRM will carry a grapple, based around those used in the loader crane and forrestry industries	Radiation and contamination levels within vaults require remote operation. Size limts with respect to vault access and subsequent deployment within vaults	It is necessary to underpin the design of the equipment to establish it's suitability for use. R&D 1	21/20056/SPEC/0185 Procurement Specification: Vault Retrieval Manipulator, Prototype developed. Contract for production of 3nr models awarded July 07. Contract terminated October 07.
Task 1.2 Initial waste sorting (1.1.5.21.14.41.21225. 34200.20052)	Waste retrieved from vault(s) is sorted to remove any waste items requiring additional treatment before transferring the waste to either the loose or containerised waste transfer mechanisms	AWVR Civil Construction	Waste sort stations are provided for each vault and are equipped with a pair of robotic manipulators.	7	Manipulators will be used to sort through the waste.	Radiation and contamination levels require remote operation	It is necessary to underpin the design of the equipment to establish it's suitability for use. R&D 2	54/00171/REP/0123A Berkeley AWVR Waste Sort Process Option Study. The specification is complete. To be procured under the main M&E contract for the AWVR.
Task 1.3 Chute Silo Waste Size Reduction (1.1.5.21.14.41.21225. 34200.20052)	Chute silo waste must be size reduced in-situ to enable retrieval.	AWVR Civil Construction	This will be achieved using a range of cold cutting techniques	7	In order to retrieve the chute silo waste it will first need to be size reduced.	Some initial trials have been performed discounting the use of hot cutting techniques. These have the potential to spread airborne contamination.	It is necessary to underpin the design of the equipment to establish it's suitability for use. R&D 3	54/00171/ DCRN/0037A Removal of Thermal Cutting as an option for Chute Silo Size Reduction (complete). 21/20056/SPEC/0154 (P1) Identification of tooling specification for chute size reduction (stopped).
Task 1.4 Chute Silo Waste Retrieval (1.1.5.21.14.41.21225. 34200.20052)	Retrieval of size reduced waste items for subsequent packaging	AWVR Civil Construction	Retrieval of waste from the chute silo will be achieved using two Waste Retrieval Manipulators. These may be a different design to the machines detailed above.	6	Waste Retrieval Manipulator. based around a conventional hydraulic crane.	Radiation and contamination levels within vaults require remote operation. Size limits with respect to vault access and subsequent deployment within silo	It is necessary to underpin the design of the equipment to establish it's suitability for use. R&D 3	54/00171/ SPEC/0098A Specification for Engineering Desk Study of Chute Silo Retrieval Machines (complete). 54/00171/ SPEC/0068A Upgrading of the Chute Silo Manipulators (tenders received but assesment stopped October 07). Chute Silo Retrieval Manipulator Refurbishment (tenders received but assesment stopped October 07)

Task ID (AWVR) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
Task 1.5 Containerised Waste Processing (1.1.5.21.14.41.21225. 34200.20052)	Containerised waste will be handled according to the container characteristics and its contents. Concept design specified, future work planned to be procured under main M&E contract	AWVR Civil Construction	Thin walled drums containing nominally dry material will be opened individually (ensuring segregation of waste streams) using a rotary shredder. The pond sludge cans, manufactured from heavy section steel tube, will be cut open using a rotary swaging technique, a plunger will remove the loose material adherred to the internal surfaces and the tube section will be flattened used a hydraulic press prior to assay and loading to the appropriate waste buffer. The sludge contents will drop into a collection tank where a high shear pump will resuspend the solids content. Sludge transferred from the sludge collection tank will be accumulated and kept in suspension in a sludge holding tank.	9	Post shredding, the solid and mobile waste may be segregated using a drum screen	Radiation and contamination levels require remote operation		54/00171/REP/0113A AWVR Project Shredding Trials Report (complete) 54/00171/REP/0133A Seperation of Shredded Waste (Complete) 54/00171/REP/0225A Cellite & Resin Rotary Screening Trials Phase 1 (complete) Area 200 Process Cell Rotary Screening Trials Phase 2 (complete)
Task 1.6 Mobile Waste Processing (1.1.5.21.14.41.21225. 34200.20052)	Mobile wastes will be blended within a compliant waste $3m^3$ drum to maximise the waste loading. The blend will include measured quantities of Ion Exchange Resin, Celite and Sludge The sludge/water suspension from the holding tank is used as the make up “water” for the cementation of mobile wastes and will be discharged to the compliant waste 3m3 drum via the WAMH in preset volumes to comply with waste product specification and formulation requirements	AWVR Civil Construction	Mobile waste will be conveyed to Intermediate Bulk Container (IBC) stations using a lean phase air conveying system. When the formulation volume of material has been accumulated, the IBC contents will be discharged into a $3m^3$ compliant waste drum via the Waste Addition and Mixing Head (WAMH). Cement powder required for mobile waste solidification will be supplied pre-blended in IBCs ready for use	7		There is a finite limit to the volume of resin that can be packaged within a compliant waste $3m^3$ drum without adversely affecting package properties. There is a bounding upper limit for the solids concentration in the sludge/water suspension. Additional water may have to be introduced into the sludge holding tank to dilute the sludge.	It is necessary to develop a modified compliant waste $3m^3$ drum for high chloride waste forms Generic R&D Work relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R&D Programme Document	54/00171/REP/0209A Vacuum Conveying Trials, Clyde Material Handling (complete) 54/00171/REP/0223A Berkeley AWVR Project, Process Description, Area 200 Mobile Fines Waste Handling System (complete) 54/00171.REP/0207A Potential use of BPS Canned Sludge as Make up Water for Celite/IX Material Solidification (complete)
	Identification of suitable formulation(s) for waste solidification.		AWVR Miscellaneous Mixed Fines encapsulation formulation trials. These will include for the minimisation / prevention of the reaction between Magnox fines and TEC powders using either: • an inert filler material or • precipitation of the TEC from the solution with the addition of a suitable nitrate	4 (for mixed fines)			There is a need to demonstrate that packaged waste properties will be acceptable for ultimate disposal. Laboratory work complete December 07 but findings are inconclusive – further R&D will be required. R&D 4	
Task 1.7 Solid Waste Processing (1.1.5.21.14.41.21225. 34200.20052)	Solid waste will be assayed and weighed prior to tipping into a $3m^3$ stainless steel compliant waste box. The waste box will be presented through a double lidded port to protect its external surfaces from contamination	AWVR Civil Construction	Boxes filled with solid waste will be grouted, with the lid having been secured using an automated robot with hole finding capability and torque sensing. Boxes will be filled with a cementitious grout at a grout station and allowed to cure prior to being capped with an inactive grout cap. Grout will be mixed using conventional construction idustry plant. Clean chilled water will be provided for grout preparation. Cement powders required for grout preparation will be stored in bulk silos external to the AWVR facility. Process has been used at Trawsfynydd site.	9		Radiation and contamination levels require remote operation		54/00171/REP/0078A Basic Design Requirements for Assay and Related Equipment in the BPS AWVR Plant 54/00171/REP/0139A Summary Report of AWVR $3m^3$ Box Grouting Trials (complete)

Task ID (CRP) (PSWBS REF)	Task/Process description	Preceding Task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
2)	**Caesium Removal Plant (CRP)**	**Overview:** The CRP contains the following waste forms: Mobile ILW - Sand and sludge from pond water filtration (10.5 m3)/ Spent Ion Exchange resin from pond water treatment (12.4m3)/ Gas drier desiccant in drums (10.6m3). Solid ILW – Miscellaneous Contaminated Items (MCI) from de-planting (5.4m3) Mobil LLW – Pond Sludge & debris from pond wall decontamination (4.5 m3) / Aloxite from Sand pressure filters (8m3) The project is currently at stage 2 - cleaning out and de-planting redundant equipment to provide space for the process plant to be installed to process the waste during stage 3. Stage 3 involves the design, procurement, construction, commissioning, operation and ultimate decommissioning of plant and equipment to process the ILW, package in waste approved containers and transport to the on-site interim store.							
Task 2.1 Sludge & ion exchange resin encapsulation (1.1.5.21.14.41.21225.34100.20061)	Co-packaged to maximise waste loading and mixed with pre-blended cement powders to form a cementitious grout in 3m3 compliant drums. NSG, Harwell, are preparing the Letter of Comfort.	CRP Stage 2 works	The blended wastes shall be immobilised using a Berkeley CRP Project designed Intermediate Level Waste Solidification Plant (ILWSP) which will be installed within the existing CRP structure. ILWSP is the Berkeley CRP Project alternative to BNG TILWSP which has been proven at Trawsfynydd	8	Waste will be retrieved from settling tanks in CRP building and transferred hydraulically. Waste will be volumetrically measured into a compliant drum located within ILWSP.	There is a finite limit to the volume of resin that can be packaged within a compliant 3m3 drum without adversely affecting package properties.	Identification of formulation(s) for maximising resin volumes in package. Demonstration that packaged waste properties will be acceptable for ultimate disposal using 360 day monitoring of cemented simulant and irradiation trials Generic R&D Work relevant to this programme are identified in Magnox Electric Waste & Decommissioning R&D Programme Document.	21/04044/REP/0072/B, CRP Strategy document for Solidification of ILW, May 2006.
Task 2.2 Tritiated desiccant encapsulation (1.1.5.21.14.41.21225.34100.20061)	Immobilised in cementitious grout in 500 litre drums. Four off 500l drums will be placed in a stainless steel stillage.	CRP Stage 2 works	Dryer desiccant will be immobilised in cement using the Low Level Waste Solidification Plant (LLWSP) modified to handle 500l drums. Desiccant will be vacuum conveyed from the storage container to the LLWSP. A package curing station will be provided with a connection to the active ventilation system to extract the tritium and discharge through the authorised discharge point. The tender for the detailed design was been issued but has now been withdrawn. Encapsulation is anticipated to be complete February 2009.	9	An amendment (increase) to the Site's gaseous tritium discharge authorisation will be granted The LLWSP is designed to be configurable to handle 500l drums therefore significant development work should not be necessary	500 litre scale is the maximum for solidification of this waste. Larger scale produces increased cure temperature with increased tritium release	The LLWSP was designed to be configurable to handle 500l drums therefore significant development work should not be necessary. Dessicant formulation work is complete and the 360 day trial results are due February 2008.	Desiccant Retrieval and Solidification Campaign Design File 21/04044/DF/0002/A (work stopped)
Task 2.3 Pond Sludge Drums Processing (1.1.5.21.14.43.21225.34100.20061)	7 No. sludge drums were physically characterised and Gamma assayed, the remaining 33 were opened, swabbed and gamma assayed.	CRP Stage 2 works	Characterisation report produced based on the results of characterisation from the 7 sampled drums. The engineering advice note is being produced based on the results of all 40 drums. Process technique will depend on drum contents. Aim to produce BPM in 2008/09. Site works were planned for April 2009 – now deferrerd.	9	Waste is a mixture of LLW and (mainly) ILW. Deferrals dependent on 'Safe & Secure' site assesment in 2008/09.		It is envisaged that proven technologies will be employed to process drums.	
Task 2.5 Solid ILW Processing (1.1.5.21.14.41.21225.34100.20061)	Any solid items found in the CRP Decommissioning Waste will be sorted and sent to the AWVR plant for packaging to compliant specifications	CRP Stage 2 works	Pipe work and components are currently housed within the CRP building and will be removed during decommissioning. This waste is designated LLW. If any is found to be ILW then it will be sent to the AWVR facility for processing as solid, surface contaminated ILW.	9	Solid ILW will be transferred to the AWVR for packaging to compliant specifications. But AWVR project has been deferred.			CRP Technical Strategy Document 21/04044/REP/0011/1 (work stopped)

Task ID (Shielded Area) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
3)	**Shielded Area**	**Overview:** The Shielded Area provided a research facility to examine fuel and irradiated components delivered from Magnox and AGR power stations. It consists of Cells, Caves, active specimen transfer conveyor system, pond , AETP and laundry. Dismantling of the Cells is in progress. The caves contain cans of ILW (14.3m3) and ILW (35.8m3) from Shielded Area decommissioning that will be transferred in shielded containers to a buffer store whilst awaiting for the AWVR waste process to be commissioned, thus allowing the decommissioning of the caves to continue. The AWVR waste process will package this waste in compliant approved containers and they will then be transported to the on-site interim ILW store. Project work has been deferred following funding constraints. However, in 2008/09, it is planned to use the facilites for legacy waste disposal to consign decommissioned items.							
Task 3.01 Cells 1 to 10 (1.1.5.21.13.34.21235.35400.20046)	These structures will be removed using standard cutting techniques.	In Progress	As far as is practicable Cells 1 to 10 will be decontaminated using the installed manipulators to swab surfaces and operate equipment such as sanders, grinders etc. to remove areas of high local dose rate. This will be followed by access through the rear cell doors for final decontamination and removal of remnant equipment. The cells' shielding will be progressively dismantled to reveal the steel clad dense concrete structure which will be removed using a combination of concrete cutting techniques	9	It is assumed that contamination levels of the cells shall not exceed C3 levels during the dismantling phase of the work.	Radiation and contamination levels require remote operation		TR/96045/002, Issue 1, Shielded Area Decommissioning Study – Options Report
Task 3.4 Caves (1.1.5.21.13.34.21235.35400.20046)	The caves will be decontaminated in a similar manner to the cells using the installed manipulators to swab surfaces and operate equipment such as sanders, grinders etc. to remove areas of high local dose rate.	Task 3.1 Task 3.2 Task 3.3 Task 3.5 Task 3.7 Task 6.2	Vacuum cleaning, swabbing surfaces and use of strippable coatings will all be used at different stages. The in-cell cranes may be used to support tools being operated by manipulators in order to access the upper areas of the cave walls. As contamination in the caves reduces roof slabs may be removed to aid cleaning of crane rail corbels and the cranes. Fully suited man access will be used when the radiological conditions in the cell permit. A suite of conventional power tools modified for remote operation using manipulators will be deployed to aid dismantling and removal of installed tools and bench surfaces. A Brokk remotely operated vehicle (ROV) will be used for dismantling the bench frames using demolition shears. The ROV may also be used for retrieval and packaging of high dose rate items from beneath the bench surfaces	9	At some stage during de-commissioning operations the radiation and contamination levels will be reduced to a level which permits man access.	Waste route for the ILW, currently stored in the cave-line, to the buffer store to be established		
Task 3.5 GEC Bay and Rail Transfer Tunnel (1.1.5.21.13.34.21235.35400.20046)	Removal of the redundant hoist Removal of the cave crane reeling drum Removal of GEC bay building fabric. Removal of the tunnel structure Removal of the monorail track Removal of base plinth	Task 3.1	Prepare safe systems of work including containment and entry/exit conditions Set up lifting and access equipment Size reduce and decontaminate equipment Remove redundant equipment Dispose of all waste through approved routes following radiological survey	9				TR/96045/002, Issue 1, Shielded Area Decommissioning Study – Options Report
Task 3.6 Magnox Dry Fuel Handling Facility (MDFHF) (1.1.5.21.13.34.21235.35400.20046)	Removal of building fabric around MDFHF to allow access Removal of in cave hoist reeling drums Removal of sliding door Removal of wall sections Removal of roof plates	Task 3.4	Prepare safe systems of work including containment and entry/exit conditions Set up lifting and access equipment Size reduce and decontaminate equipment Remove redundant equipment Dispose of all waste through approved routes following radiological survey	9				

Task ID (Shielded Area) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
Task 3.7 Pond (1.1.5.21.13.34.21235. 35400.20046)	Installed pond filtration media will be discharged through operational waste routes and equipment removed, size reduced using conventional cold cutting techniques and disposed of as LLW to the repository	Task 3.4	A series of pontoons will be used to provide a working platform within the pond. The pond water level will be progressively reduced to enable decontamination of the pond wall surface. Conventional tools will be deployed to characterise the pond wall surface and be used to remove contaminated material. Removed material will be treated as low level mobile waste and will be solidified in 200 litre drums using the Low Level Waste Solidification Plant. Pond water will be treated and discharged in accordance with the site discharge authorisation via the Active Effluent Treatment Plant (AETP). The Pond Structure will be demolished using an appropriate technique dependent upon the depth to which contamination has penetrated the concrete	9	It is assumed that scabbling of concrete to a depth of 3mm will be sufficient to meet safety case requirements for decontamination	The pond currently provides a ventilation seal to the caves, this seal needs to be maintained until the caves no longer require containment depressions		
Task 3.8 Active Effluent Treatment Plant, Active Drains, North & South Vaults (1.1.5.21.13.34.21235. 35400.20046)	The AETP will be de-planted and size reduced using a range of conventional hand held proprietary tooling and be disposed of as LLW to the repository.	Task 3.7	Final flushing will be required to reduce activity levels within the associated ADR and final holding tanks and associated pipe work. . Sludge and filter media will then be packaged using the Mobile Low Level Waste Plant in accordance with current BNLS procedures and disposed of as LLW to the national LLW repository.			The active effluent treatment plant (AETP) needs to be retained until the pond has been drained & until the shielded area laundry is no longer required or alternative arrangements have been made.		
Task 3.9 Ventilation System (1.1.5.21.13.34.21235. 35400.20046)	Ventilation system removal typically includes; Removal of duct, dampers, filters and filter housings, fans, motors, monitoring equipment, control & instrumentation, control panels, switchgear, cabling , trunking, waster systems, heater batteries, air supplies, support steelwork.	Tasks 3.1- 3.10	The Shielded Area ventilation system comprises five separate systems which are all interlinked by the air flows within the buildings. This system is managed by a Programmable Logic Control (PLC) system to ensure that the direction of air flow from clean areas to dirty areas is always maintained. Decommissioning of the Shielded Area will steadily progress with cells and contaminated areas gradually being disconnected from the ventilation system. As facilities are removed from the system the control and instrumentation signals for each will be modified to show system healthy. Air will then be bled into the effected system duct to maintain the mass flow rate thereby maintaining the overall system's balance.	9		The complete ventilation system must be maintained until the Shielded Area and the caves have been decontaminated and the risk from airborne contamination has been minimised.		TR/96045/002, Issue 1, Shielded Area Decommissioning Study – Options Report
Task 3.10 Sources and Source Stores (1.1.5.21.13.34.21235. 35400.20046)	To dismantle the source stores and dispose of sources. The following Shielded Area stores were completed: No. 16 (cell 11), 38, 39, 54, 57, 62, 63 & 66 (cell 9) Nos 58&59 were emptied but could be recommissioned as required.	Disposal of sources	Preparation of safe systems of work Identification of sources and relocation to source stores to be retained Disposal of sources Decontamination and size reduction of source stores		Approval for disposal of sources from Nexia Solutions.	The following stores have been retained Nos 36, 55, 61, 49 & 59.		

Task ID (Conventional) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
5)	**Conventional Plant Area De-plant and Demolition**	**Overview:** This includes the offices and laboratory facilities on the Berkeley Centre part of the site						
Task 5.1 (1.1.5.21.13.34.21230. 34300.20130)	There are numerous buildings and plant outside the RCA that require demolition during the C&M Preps phase	In Progress	These facilities will be surveyed and characterised to assess hazardous material content, scope of work, the requirement for risk assessments etc prior to demolition. Hazards such as electricity, asbestos, mercury etc will be isolated and removed. Peripheral plant & equipment will be removed using conventional techniques involving both manual and mechanical means as appropriate to the task. Recycle and reuse of materials will be maximised	9	Relocation of the corporate IT and Communications systems is complete by 31 March 2008, but there is a proposal to separate BNLS from the corporate IT system, All tenants' personnel will have left the Berkeley De-licensed Site. Buildings A11 and A12 will remain with stand alone services from December 2007.	The Infrastructure systems and services to be relocated include the following: British Nuclear Group corporate IT/communication systems. ESTL IT systems (to be relocated by others). Berkeley Site Communications systems. Archived documents, awaiting NDA guidance. Stores and good inwards to BNLS PS. Emergency vehicles to BNLS Gate house security systems to BNLS A21 will be relocated to the Berkeley Licensed Site to be used as the project team office. Occupational Health to BNLS	Demolition will utilise standard industry techniques	BNLS/MIS/0092, The Berkeley Delicensed Site Demolition Plan

Task ID (ILW Store) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
6)	**ILW Store**	**Overview:** The ILW Store will provide passive, safe and secure long term storage for packaged ILW on the BNLS until such time as the ILW can be exported for final disposal						
Task 6.1 Interim ILW Store (1.1.5.21.11.12.21245. 36600.20090)	The ILW Store will provide passive, safe and secure long term storage for packaged ILW on the BNLS until such time as the ILW can be exported for final disposal The outline design of the ILW store is complete. Due to funding constraints the construction of the ILW Store is deferred. However, during 07/08 works will continue on detailed design to: • Complete the preconstruction safety review and INSA 5b form for ILW store foundations • Develop appropriate ventilation system	Gate 3 approval has been given for the contracts to construct the ILW Store. Note that minor preparatory works to secure on-going planning approval will be undertaken, ie, tree planting and 1m fill to piling mat	The Best Practical Environmental Option (BPEO) and Best Practical Means (BPM) considered the key factors in determining the location of a new ILW Store at BNLS, including the proximity of the site boundary and dose implications. The findings from this report indicate that it is feasible and beneficial to build a new ILW Store at Berkeley. The new store will be located on the north side of the site, maintaining the specified distances from the perimeter fence and ensuring access for construction and other vehicles. This facilitates construction to be undertaken out side the RCA area. A detailed feasibility study has been completed and the Environemental Impact Assessment submitted and subsequently approved in August 2007.	7	The previous solution to the storage of ILW waste was to utilise an existing building, namely the basement of Blower House A, Reactor Building 2 (R2A). This design has not been progressed as: • The ILW store design may not be able to achieve a safety case. • Following modification, the ILW store crane may not perform as planned leading to crane operational difficulties. (due to curved crane rail). • National Waste Managing authority may not approve the ILW storage conditions.	Ease of Construction Interfacing with Donor Facilities Package Recovery and Transfer to a National Repository Proximity to Site Boundary Proximity to Other Facilities Provision of Access Ground Level Conditions Ground Conditions Piled foundations with high secondary response to seismic events in the structure Availability of Adjacent Areas An aim to provide a ventilation system that can disperse Hydrogen in early years and control ongoing humidity levels to <80%.	Generic R and D Work relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R&D Programme	54/00171/REP/0227 Berkeley ILW Store, Initial Feasibility Report

Task ID Partial Site De-licensing (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
7)	**Partial Site Delicensing**	Completed – see Table 1B						

Task ID (Contaminated Land) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
8)	**Contaminated Land**	**Overview:** Ground surveys have been conducted on the site and characterisation data have be generated for areas of contaminated ground on Berkeley site. This will aid to ensure passive safety during Care and Maintenance and takes into account the intention to de-lincense the site during Final Site Clearance. A position statement on the need for a safety case for radioactively contaminated land, in accordance with the Land Quality Standard (ME/S/154), will be completed in March 2008.						
Task 8.1 (1.1.5.21.13.36.21250.36900.20010)	BNLS will generate sufficient characterisation data for areas of contaminated ground on the Site.	Tasks1 to Task 7	The main strategy options include: Removal of contamination (e.g. by excavation). Enhanced containment in situ. Monitoring of the contamination in situ without engineered enhancement of containment. For each of these options, there are a number of technical approaches and considerations to be made, all of which will be assessed for BNLS specific application e.g. Excavation and removal requires consideration of the options for treatment, storage and disposal of the resulting waste. Retention of residual contamination in the ground requires safety justification for the duration of Care and Maintenance and adequate characterisation is essential. This includes a desk-based review of historical information on spills/leaks, contaminated ground management, monitoring and site hydrogeological mapping followed by intrusive (borehole investigations) and non-intrusive (e.g. surface radiological surveys) characterisation methods.	9	The Company has a contaminated land Intelligent Customer capability	Non-radioactive contamination is not directly relevant to eventual de-licensing of sites, but may influence future land use		1C3/0147/REP/001, Design of De-licensing Surveys for the BNLS

Task ID (Safe Store Preparations) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
9)	**Safe Store Preparations**	**Overview:** The end state of the site following completion of the C&M preparation phase will comprise of the two reactor buildings and the ILW store in safestore and those services required to operate the site through the C&M period. All other buildings will have been demolished to ground level; voids filled and the site patrially landscaped to ensure no hazards. The remaining hazards on the site – the two reactors and the 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 ILW repository when it becomes available.						
Task 9.1 (1.1.5.21.13.31.21240. 36200)	Following the C&M Preps period, it is proposed that the Site moves into a quiescent C&M phase during which it is maintained in a safe and secure state.	Tasks1 to Task 8	The strategy for the development of the Safestore structure is outlined below:- Define the Reactor Safestore for the Care & Maintenance Period (C&M Period). This activity will define the physical appearance and structural requirements of a Reactor building in "Safestore". Mapping & Characterisation of plant within the Reactor buildings to identify radiological and conventional hazards. Implement identified structural modifications, security and plant monitoring arrangements to the Reactor buildings required for the Safestore period to ensure safe containment of remaining hazards for example: Reactor core materials. Develop safety case to support the Reactor Safestore for the C&M Period. Proprietary materials and conventional techniques will be used for Reactor building modifications and an inspection / maintenance regime will be set up for the C&M period to identify and undertake building repairs.	9	The inspection, monitoring and maintenance regime will be based on the requirements of the safety case and relevant legislation. The robust nature of the modified reactor buildings and storage facilities will ensure minimal need for human intervention during this period	A national ILW repository is planned to become available during 2040, disposal of ILW to this facility from BNLS will be between 2046 and 2049.	Generic R and D Work to develop opportunities relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R&D Programme document	ME/S/036 Magnox Electric's Decommissioning and Radioactive Waste Management Strategy

Task ID (FSC) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
10)	**Final Site Clearance (FSC)**	**Overview:** At the end of the FSC period all of the radioactive structures, including those 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. Any remaining significant ground contamination will have been removed. Finally, the Site will be subjected to extensive radioactvity surveys to confirm that no unacceptable radioactivity remains on or below the site and that the site can be delicensed. Back to Bio Shield work has already been completed at Berkeley with boilers laid down and sealed, ductwork cut and capped and the reactor structures weatherproofed.						"Scope Module – FSC Reactor Dismantling" reference 36200.ECC00 LCBL Detailed Volume , Reactor Vessels – FSC Installation of Reactor Dismantling Equipment LCBL Detailed Volume Heat Exchangers & Primary Circuits: FSC Heat Exchanger & Primary Circuit Dismantling LCBL Detail Volume, Reactor Vessel: FSC Reactor Dismantling LCBL Detail Volume, Reactor Building: FSC Demolition of Reactor Building LCBL Detail Volume Waste Store (ILW): FSC Demolish ILW Store
Task 10.1 (1.1.5.21.13.34.21240.36200.ECC00) and (1.1.5.21.13.34.21240.36300.EDD00)	Preparatory Works and Access Reactor Pressure Vessel	C&M Preps	Necessary site infrastructure is re-introduced to the site to support Final Site Clearance including necessary waste handling facilities, services, accommodation, encapsulation plant etc. Remove control rods and other long items from reactor core and surrounding voids. Open access routes into the space between the steel Reactor Pressure Vessel (RPV) and the concrete bio shield. Break through the pile cap and into the RPV.	1	A containment building will be constructed over the pile cap area. All thermal lagging will be removed using conventional industrial procedures. Conventional industrial diamond drilling and cutting procedures will be used	Access into the voids surrounding the reactors may only be possible after the Reactor dismantling has been completed.	Currently a feasibility study is being conducted to determine the site-specific enabling works required under the proposed 25 year FSC strategy. Generic R and D Work relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R&D Programme	
Task 10.2	Preliminary Reactor Dismantling		Erect containment between the top of the RPV and the newly formed sides of the penetration in the pile cap. Progressively remove the Stand pipes Install lighting and Closed Circuit Television (CCTV) in the RPV. 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 RHMs.	1	Remote Handling Machines (RHM) to be used in the RPV are presently based on proprietary equipment such remotely operated Brokk vehicles.		Generic R and D Work relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R&D Programme	
Task 10.3	Graphite Removal		RHMs 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.	1	Displaced bricks to be transferred in skip to the pile cap for disposal via the newly constructed waste processing facilities and available waste routes.		Graphite Deposition Project. Generic R and D Work Area(s) relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R+D Programme	

Task ID (FSC) (PSWBS REF)	Task/Process description	Preceding task	Technique	Technology Readiness Level (TRL)	Assumptions	Technical Constraints	Gaps (ref to R&D table)	Key Reference Documents
Task 10.4	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.	1	The RPV will be cut away using conventional industrial procedures utilising the external scaffolding/staging.		Contaminated & Activated Metals. Generic R and D Work Area(s) relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R+D Programme	
Task 10.5	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.	1	The removal the diagrid and remaining steelwork will be done using conventional industrial procedures.		Generic R and D Work relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R&D Programme	
Task 10.6	Radial Shield and Bio shield Removal		Remove the radial concrete shield and then remove the inactive concrete bio-shield. Survey and monitor remaining building structure, decontaminate as appropriate and demolish utilising industry standard techniques.	1	Remove the concrete structures will be done using conventional industrial / demolition procedures.		Concrete ILW disposal Generic R and D relevant to this programme are identified in the Magnox Electric Waste & Decommissioning R+D Programme	
Task 10.7	Site End State	**Overview:** The end-point of the FSC period is therefore assumed to be a delicensed green field 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.						
Task 10.8	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, dependant on the agreed site end state.	3	It is assumed the site end state will be delicensed, requiring the removal of all contamination.	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.	
Task 10.9	Landscaping		The land will be landscaped to make it acceptable for future usage.	9				

Table 1B: BNLS, Technical Baseline: Changes from FY 2007-08 submission – Work completed or deleted

Task/Process ID	Task/Process Description	Identification of change	Impact of change
2) CRP **Task 2.4:** Aloxite Processing	Option of dewatering aloxite was undertaken in preference to its imobilisation in cement using the Low Level Waste Solidification Plant (LLWSP).	Completed	This novel approach reduced the number of ISOs required from more than 30 to 2 or 3 and has resulted in cost savings
3) Shielded Area **Task 3.2:** Air Tube Conveyer System (ATCS)	Lead shot shielding will be drained under gravity into 200 litre drums. The plastic conveyor tubes will be removed manually using cold cutting techniques and extended reach tooling when necessary. The diverter unit will be supported and lowered onto machine skates when cell 15 has been dismantled.	Completed	ATCS dismantled
Task 3.3: Cells 11 to 17	Cell suites 11, 12, 13, 14, 15, 16, and 17 containment boxes will be treated in a similar manner to the inner surfaces of Cells 1 to 10.	Completed	When cells are reclassified down to C2 the ventilation system will be disconnected, sufficient dismantling will then be undertaken to enable removal of the inner containment box. Remaining steel slabs will then be dismantled
6) ILW Store **Task 6.2 ILW Buffer Store**	In order to progress de-licensing of the South end of the Berkeley Site, Intermediate Level Waste has been transferred from the Berkeley Centre ILW store (C35) to the Shielded Area caves for temporary storage. The purpose of this project is to create a facility that will provide the opportunity to continue the decommissioning of the Shielded Area and prevent delays and subsequent cost increases. Planning permission has been given for the buffer store.	Deleted	The buffer store has been removed from the baseline plan and the concept is no longer being pursued.
7) Partial Site Delicensing	The south part of the Berkeley Centre site that mainly has office or conventional laboratories is to be de-licensed. Buildings used for LLW activities have been surveyed and wiil be demolished.	Completed	Reduced site management costs by the lifting of nuclear site license requirements.

Table 2: Berkeley Nuclear Licensed Site Research and Development Table.

Generic R&D work is being undertaken and managed through the Decommissioning Strategies Organisation (DSO) and the Reactor, Waste & Decommissioning Technology Group (RWDTG). Strategies will be implemented at BNLS as appropriate. Details of the 2008 - 09 generic R&D work can be found in the Magnox Electric Ltd Waste Decommissioning Research & Development Programme.

Task ID	Technical Need - Task + Gap	Why R&D work is needed	Target Dates	Cost Range	Need / Risk/ Opportunity	Site/Generic/NDA Issue	Output / Action(s)
Task 4.2 Install Mobile AETP (1.1.1.21.11.11.21.21210)	Modular Active Effluent Treatment Plant (AETP) to replace those in BPS and BC. Linking into existing active effluent system outlets and to discharge lines on site	Existing technology to be utilised and engineered to meet the needs of BNLS.	Oct 09	£100k to £1M	Existing technologies are available.	Site	Develop BPM document for AETP, review options; complete concept design followed by detailed design.
Task 4.3 BPS AETP Oily Sludge (1.1.5.21.14.43.21035.21180)	Inspection of 37 drums and development of more efficient methods of disposal, eg drying followed by incineration.	To underpin potential disposal methods to establish suitability for use.	March 2009	< £50k	To enable a more efficient and cost effective disposal route These sludges have previously been encapsulation on this site.	Site	Disposal of 37 drums of oily sludge legacy waste from the BPS AETP

Table 2 A: BNLS, R&D work on–hold during FY2008-09

Task ID	Technical Need - Task + Gap	Why R&D work is needed	Target Dates	Cost Range	Need / Risk/ Opportunity	Site/Generic/NDA Issue	Output / Action(s)
R&D 1 Task 1.1 Active Waste Vaults Retrieval and Processing. (1.1.5.21.14.41.21225. 34200.20052)	Develop prototype retrieval machine.	It is necessary to underpin the design of the equipment to establish it's suitability for use.	Project suspended October 2008	£100k to £1M	Need BNLS risk serial number v2	Site	Identification/proving of suitable machine for waste retrieval from vaults: Vault Retrieval Manipulator Specification & Prototype developed.
R&D 2 Task 1.2 Active Waste Vaults Retrieval and Processing. (1.1.5.21.14.41.21225. 34200.20052)	Validation of OR model.	Input required for Operations Strategy Document	Project suspended October 2008	£50k to £100k	Need BNLS risk serial number v19	Site	Updated OR model in line with current Mechanical Basis of Design: Waste Sort Process Option Study specification complete,
R&D 3 Task 1.2, 1.3 & 1.4 Active Waste Vaults Retrieval and Processing. (1.1.5.21.14.41.21225. 34200.20052)	Develop sort manipulators and chute silo tooling.	It is necessary to underpin the design of the equipment to establish it's suitability for use.	See Outputs / Actions	£50k to £100k	Need BNLS risk serial number v33	Site	Identification/proving of suitable equipment for waste sorting and size reduction operations: Removal of Thermal Cutting as an option for Chute Silo Size Reduction Identification of tooling specification for chute size reduction. Specification for Engineering Desk Study of Chute Silo Retrieval Machines Upgrading of the Chute Silo Manipulators Chute Silo Retrieval Manipulator Refurbishment

Table 2B: BNLS, Changes from 2007-08 R&D submission – work 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
R&D 5 Task 2.1 CRP Decommissioning (1.1.5.21.14.43.21225. 34100.20061)	Demonstration that packaged waste properties will be acceptable for ultimate disposal		August 2007 (360day monitoring period ends August 2008).	£105k	Completed	Identification of suitable formulation(s) for waste solidification
R&D 6 Task 2.4 CRP Decommissioning (1.1.5.21.14.43.21225. 34100.20061)	Aloxite retrieval and solidification trials Demonstration that packaged waste properties will be acceptable for ultimate disposal and that waste may be retrieved and dispensed into waste containers.		Completed October 2007	£50k to £100k	Completed	Option of dewatering aloxite was undertaken in preference to its imobilisation in cement using the Low Level Waste Solidification Plant (LLWSP). This novel approach reduced the number of ISOs required from more than 30 to 2 or 3 and has resulted in significant cost savings.

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8. Figures

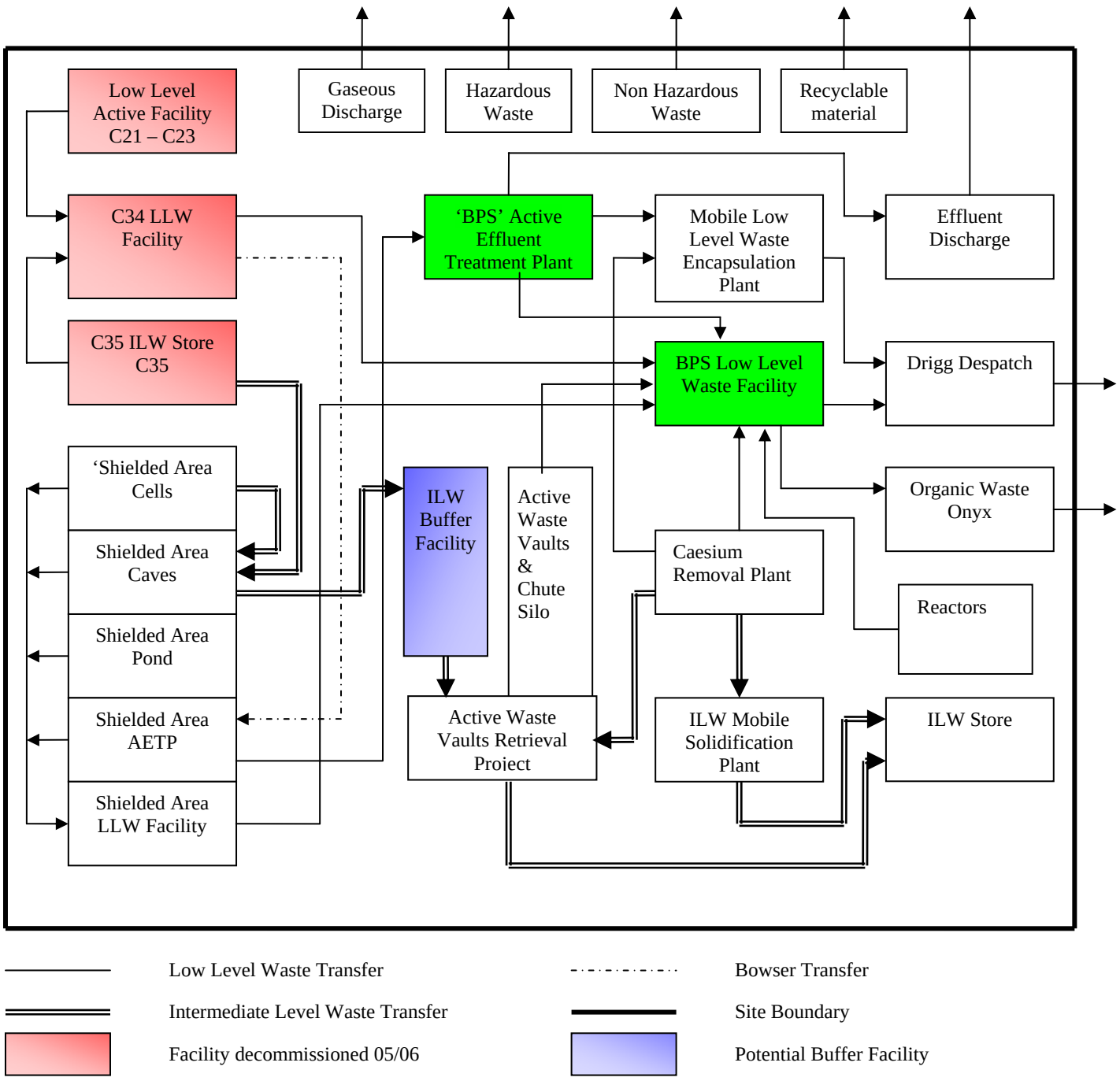

Figure 1: Care & Maintenance Preparations Phase Process Flow Diagram

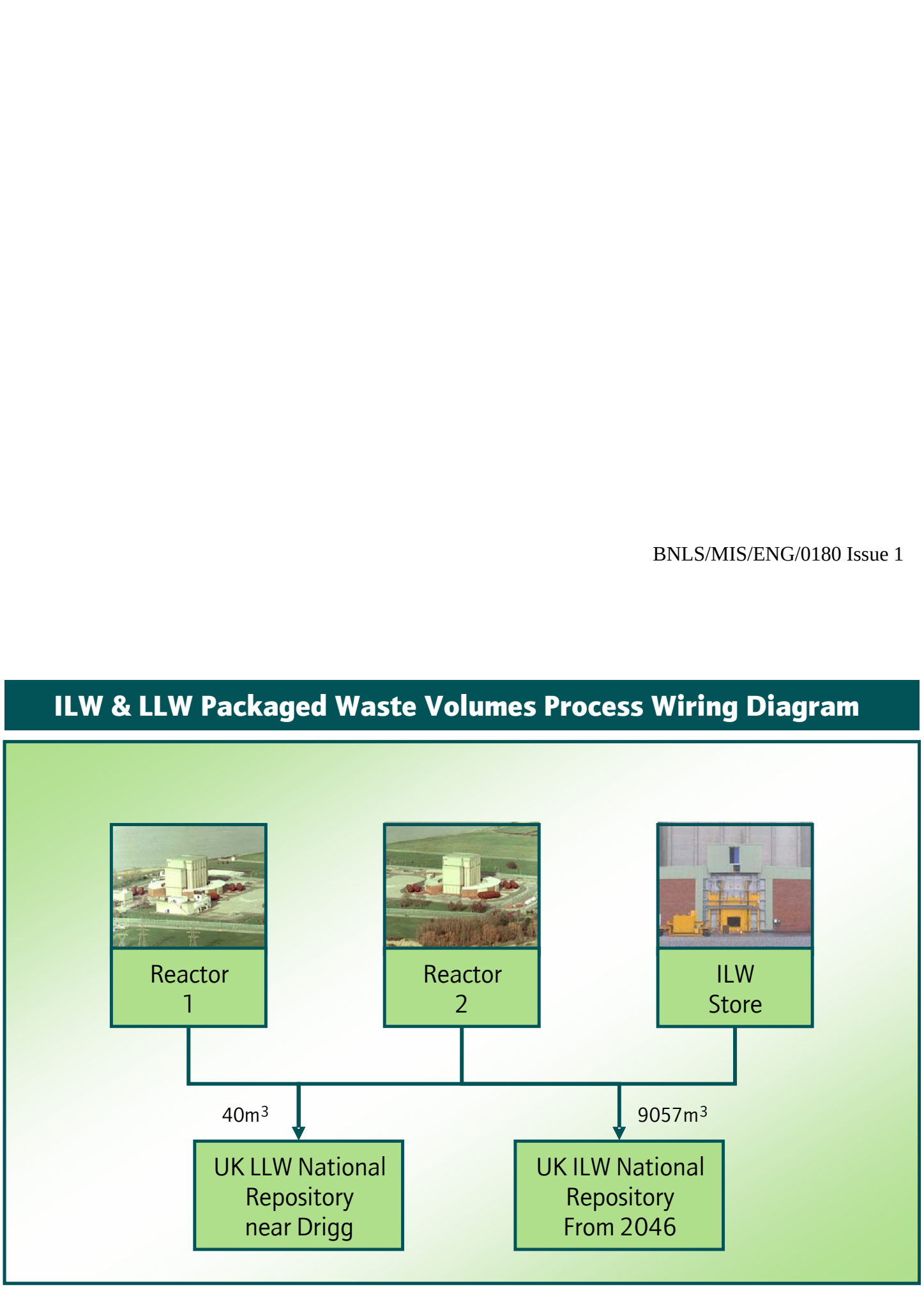

Figure 2: Care & Maintenance Phase Process Flow Diagram