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RADIOLOGICAL SAFETY ISSUES FOR SPENT FUEL WET STORAGE (PONDS) FACILITY DECOMMISSIONING AT U.K. MAGNOX POWER STATIONS

Matthew Tuck
Matom Radiological Services Ltd, Capel Salem, Bryncelyn Road, Talysarn,
Gwynedd, Wales, UK LL54 6AB
matt@matom.com

Peter Blott
BNFL British Nuclear Group, Trawsfynydd Decommissioning Site, Blaenau
Ffestiniog, Gwynedd, Wales, UK LL41 4DT
peter.blott@bnfl.com

ABSTRACT

The Decommissioning of the Trawsfynydd Cooling Ponds was phased with the initial contract awarded for Ponds Furniture Removal. The ambitious programme timescale, planned number of workers, and hostile radiological environment for both external and internal dose provided a challenge to the Contractor and BNFL alike. Dose management techniques proved critical in controlling the exposure of personnel in a number of ways. These were daily dose recording and review, occupancy management, distancing, and use of temporary shielding. Waste management covered the packaging of waste stream containers and minimisation of ILW generation by development of a unique assay and sentencing technique. This paper briefly addresses these issues as part of a constrained decommissioning objective.

1. Introduction

This paper forms the prime review of decommissioning for commercial nuclear power plant spent fuel wet storage facilities in the U.K. It addresses the radiological safety issues for stages of the decommissioning programmes at Trawsfynydd Decommissioning Site (formerly nuclear power stations).

A review of the management of worker dose in high dose rate environments, at different stages of the decommissioning programme, is presented. Variations to the programmed work, and changes in the radiological environments i.e. contamination and dose rate levels, were common, and were problematic in terms of ALARP management.

Also reviewed, with environmental relevance, is the radioactive waste (low level waste (LLW) arisings from the project, which provided an insight into the need to fully understand project scope when considering volumes of radioactive waste material to be generated.

1.1 Overview of Magnox Nuclear Power Plant

Magnox Nuclear Power Stations were the first commercial reactors in the UK, commencing operation with Calder Hall in 1956. Wet storage facilities, termed ‘Ponds’, have provided the principal form of spent fuel storage for all of these reactors. The Ponds complex is considered as the main wet storage area (ponds), and the Pond Water Treatment Plant (PWTP) process area. Other plant operations exist within these buildings that will be site specific, and given current practice of being considered separately as decommissioning objectives, will not be considered further within this study.

The Pond facilities for Trawsfynydd are shown in Figure 1 relative to the 2 reactor buildings, which both served the Ponds. Spent fuel rods were transferred from the reactor buildings via fuel chutes. The fuel elements were received into the Ponds below the water line and allocated to storage crates. Full crates were stacked appropriately within the Pond lanes.

The first stage of Pond Decommissioning involved removing the fuel, which took 2 years to complete. The decision was then made to remove the water from the Pond lanes and acceptance bays, which was completed in 1999.

Various minor post operational clean-out (POCO) tasks were performed in the area, both within the Pond lanes and acceptance bays, in addition to the walkway level, in the period prior to the Pond Furniture Removal Project being awarded to a contractor.

1.2 Radiological Conditions within the Ponds complex

For the purposes of planning and designating radiological safety controls, magnox nuclear power plants are considered to have two distinct areas, namely the reactor buildings area and the Pond complex. This is based on the analysis of extensive sampling and health physics survey results for all areas. Analysis[1] has led to the formulation of a radiological ‘fingerprint’ for each area. The fingerprint data for the Pond area is shown in Table 1 and is presented as a ratio to caesium-137 (Cs-137).

Table 1: Fingerprint for fission products and actinides shown as a ratio of nuclide activity to Cs-137 activity and decay corrected to 1st Aril 1998.

Sr-90	2.38E+00
Ru-106	1.27E-01
Cs-137	1.00E+00
Pm-147	1.35E+00
Pu-238	9.16E-02
Pu-241	2.14E+00
Am-241	3.31E-01
U-235	5.89E-06
U-238	2.59E-04

It can be observed above that the nuclides present in similar ratios to Cs-137 are Sr-90, Pm-147, Pu-241, and Am-241, giving contributions from gamma, beta, and alpha radiation emitting radionuclides.

In summary, this differs from the reactors area in that there is no significant alpha emitting hazard within the reactor area, with the radiological hazard presented by a combination of activation products and fission products (to a much lesser extent). The hazard presented in these locations is considered in terms of beta and beta/gamma exposure, and so limiting the impact of elevated dose rates is the principal risk reducing effort.

Within the Ponds complex the radiological hazards are increased, particularly in the Ponds proper, due to many years of operation in a hostile working environment. Manual and mechanical techniques were used to operate the plant that were aggressive in nature, particularly by modern standards, and this led to a build up of debris in the Pond lanes that included components of fuel elements such as mnemonic springs that were highly activated. Most fuel element debris was retrieved from the Pond lanes and acceptance bays up to the initial stage of decommissioning when Pond water was removed. However, all debris could not be successfully removed given the plant configurations within the acceptance bays, in particular, that inhibited access for retrieval. Therefore, the radiological hazards were diversified due to the range of sources of the contaminating materials.

Pond lanes were drained in 1998/1999, which immediately led to the originally submerged Pond and acceptance bay walls, base, and operating plant drying out in a ventilated environment. The slow draining of the Ponds resulted in the suspended radiological contaminants adhering in a layer on the side walls, and to a greater extent the base of the lanes and bays. Thus, the contamination environment was established for all future decommissioning works, with the focal point for radiological hazards being below the walkways.

1.3 Regulatory Controls

The regulatory controls for work with ionising regulation were revised in 1999, for implementation from January 2000[2]. Whilst maintaining many of the effective features of the Ionising Radiations Regulations 1985 (IRR 85), the new Regulations implemented, and extended, aspects of other domestic health and safety legislation, particularly with respect to risk management. A significant controlling directive was the 1996 Basic Safety Standards Directive (BSS Directive)[3] which reflected the 1990 recommendations of the International Commission on Radiological Protection (ICRP60). The implementation of the BSS Directive in Great Britain is achieved by a mixture revised regulations (IRR 99), existing legal provisions, such as the Nuclear Installations Act 1965[4] (NIA 65) and the Radioactive Substances Act 1993[5] (RSA 93), and new provisions, for example proposed regulations on emergency preparedness.

New dose limits were set in IRR 99 for employees, trainees, pregnant women, and other persons. For employees, aged 18 and above, the limit on effective dose is set to 20 mSv in any calendar year. Prior to this, as set by IRR 85, the limit on effective dose was 50 mSv in any calendar year.

On nuclear licensed sites operated by BNFL, as British Nuclear Group, there is a corporate limit on effective dose to an employee or other personnel working on the site of 20 mSv in any calendar year. The site target for projects is set at 10 mSv, with the Ponds

Furniture Removal Project set to 8 mSv per calendar year to allow for any unidentified internal dose contribution.

2. Trawsfynydd Ponds Furniture Removal Contract

It is important, from a radiological prior risk assessment aspect, to address the nature of the contract technical specification, and the information available for planning. The radiological data issued with the Invitation to Tender[6] for the Ponds proper is summarised in Table 2 below.

Table 2: Radiological Conditions for Trawsfynydd Ponds – March 2002

Area	Hand Rail Level			Down Drained Lane		
	Walkway (µSv/h)	Over Bay (µSv/h)	Floor swab*	Waist height dose rate (µSv/h)	Floor level (mSv/h) General	Floor level (mSv/h) Maximum
North A-B	40	90	60	600	0.8-1.5	200
North Corr.	40	100	50	300	0.6-1.8	20
North A-B lane	50	180	30	800	2.0-4.0	40
North C-D lane	40	80	30	Similar to South C-D		
Central A-B lane	60	120	40	700	2.0-4.0	>10**
Central C-D lane	50	100	40	700	0.5-0.6	25
South A-B lane	20	60	40	Similar to South C-D		
South C-D lane	70	130	40	300	0.3-1.0	25
South Corr.	50	70	40	Similar to South C-D		
Centre Walkways	120	210	150	Sludge gulping pipework on walkway with hot spots 4-23 mSv/h		
Flask Wash Down Bay	12	150	40	2 boxes of grouted ponds debris present in FWDB		

Note:
Floor swab* A swab of 20 cps ß approximates to 4 Bq/cm^2. The above swab levels are taken following minor cleaning.
>10 mSv/h** Measurement limited by instrument limit of detection.
All dose rates are gamma dose rates. As rule of thumb, waist height beta dose rates are 2.5 times the gamma and contact beta dose rates are 10 times the gamma.

2.1 ALARP Assessment

The routine radiological survey data presented in Table 2 was used for the project ALARP (As Low As Reasonably Practicable) assessment in association with information on the project programme and resource allocation to specific tasks.

The programme of works for the project was separated into tasks under a number of Method Statements (Work Instructions) which are presented in summary in Appendix I. These tasks were set over a programmed duration of 8 months with a resource of 12 operational men and 5 operational health physics staff.

The ALARP assessment considered the work, and methods that were optioned to reduce exposure, to give exposure estimates for individuals and worker groups for tasks, and the project. Using occupancy data from the programme of work, the total dose for the project was calculated to be 210 mSv.

This assessment presented an immediate challenge as the estimated total dose meant the work could not be completed with the number of men identified for the project assuming the dose target be met for each individual, as presented in the simple calculation below:

12 men x 8 mSv = 96 mSv (8 mSv project target)

12 men x 10 mSv = 120 mSv (10 mSv BNFL corporate limit)

This initial ALARP assessment raised issues between the principal contracting organisation and the customer, BNFL. These were focused on the data used in the assessment. BNFL requested a review of the contractor's assessment since they believed the total dose would be approximately 15 per cent less given their experience gained in POCO operations. Additional survey data was not forthcoming as contract documentation, and so the contractor could not review the assessment without contract documented evidence supplied by BNFL.

BNFL performed a separate assessment to reflect the additional information available[7]. This gave a calculated total dose of 180 mSv for the project, still much higher than was apparently achievable with a team of 12 operatives over the programmed period of work.

As the contract was awarded against a fixed price, the appointed contractor was not in a financial position to immediately increase the number of operatives, and without a formal request from BNFL to do so, was not in a position to pass the cost back to the customer. Therefore, a review of the task management and dose monitoring was required to enable the contract to proceed.

2.2 Task Management and Dose Monitoring

Given the limited radiological conditions information available and an ambitious programme, it was decided that the day-to-day task management and dose monitoring would provide the most effective means of limiting the exposure of operatives and health physics staff, assuming engineering controls, shielding requirements, operator distancing etc. had been identified in the detailed Method Statements. As a pre-requisite to each days programmed work a radiological survey of the local area would be performed, and reviewed, to determine whether refinements were required in the working practice to address hot spots etc.

i. Task Management - Work teams were required to read and sign on to the relevant method statement before commencing tasks. Additionally, each morning at the access to the area, each team would be briefed as to the days work, and any hot spots of radiation or areas of loose contamination to be considered. An operational supervisor was present in the general work area during all work.

ii. Dose Monitoring – Each operational and health physics person entering the area to support a decommissioning task was issued with dosimetry for personal dose monitoring purposes. Firstly, and as a legal dose monitoring and assessment requirement (Reference 2), a legal dosemeter (for example film badge, TLD) was worn. The type used depended on that selected by the organisation's Approved Dosimetry Service (ADS). Secondly, each person was issued with a BNFL direct reading electronic dosemeter (Siemens EPD type). These were issued on a Pond 'entry' basis. Each EPD required a unique job number to be input prior to it being authorised for use. This served to input a tasked limit for exposure to dose rate and accumulative dose against each method statement/task, above which the EPD would go into alarm mode. Each person would be electronically reviewed against daily, monthly, and annual limits each day to ensure that no individual was receiving greater than any control or legal limit.

Internal dose monitoring was performed by a combination of bioassay, and environmental monitoring within the work area using a combination of static and direct reading alpha in air) sampling units. The alpha in air unit (Harwell Instruments AB96) was set to alarm at 3 levels for this project, as shown in Table 2.

Table 3: Activity in air alarm settings for AB96

Level	Alpha Settings	Beta Settings
2	2.0Bqh/m^3	2000Bqh/m^3
3	4.0Bqh/m^3	10E+4Bqh/m^3
4	160Bqh/m^3	10E+5Bqh/m^3

The alarm levels were set against the site area limits for contamination control. The BNFL area designation limits of relevance to this project are C3 and C4, 0.01 Bq/m^3 alpha and 1.0 Bq/m^3 alpha respectively. The AB96 alarm level 2 reflects quarter concentration value of C4, and level 3 reflects half concentration value of C4.

The assessment for legal internal dose purposes was done using the static air sample analysed in the health physics on-site laboratory. These results were averaged over an 8 hour (working) period.

All of the work in the Ponds was performed with C3 controls, which included specific dressing requirements and the use of negatively pressured respirators. The action was set for evacuation from an area should the level 2 alarm be activated. This meant that unless there was a dramatic increase in the airborne contamination level i.e. into C4 conditions, there would be a low potential for a person to receive an internal exposure.

The high risk work location, with respect to dose rates and airborne contamination, was the base of the pond lanes and acceptance bays. Within the pond lanes the contamination as extremely mobile, and a minor activity, such as walking in the lane, would cause a level 2 alarm.

Monitoring the duration of man access for a specific task was achieved using a ‘buddy’ system, which timed the access against a nominated exposure limit. This limit would have been calculated following the health physics survey of the area.

2.3 Hazard Reduction Measures

The contamination within the pond lanes presented an immediate hazard for consideration. The pond environment was very dry, particularly the walls and base of the lanes and re-suspension of material was common. Spraying water into the lanes prior to access, in combination with use of a local ventilation system, significantly reduced the airborne contamination levels and incidents of AB96 alarm. Access into the lanes/bays was greatly facilitated by the use of proprietary system scaffold towers. The erection of towers was performed in a low dose rate area (e.g. former flask wash down bay) and then craned remotely into position. The use of conventional scaffold within the lane environment was minimal. Where this was unavoidable (e.g. acceptance bay upper ventilation ductwork removal) the suspended variety was the preferred choice for setting up a work platform.

Fundamental to airborne contamination control was the use of portable extract units, aqueous spraying and alarming alpha in air monitors close to the point of work. Although not directly controlling external dose uptake, such measures, if not properly executed, resulted in avoidable alarms inevitably increasing the time taken for tasks to be completed. In the case of powered cutting, the application of a fixative spray both internal and external to the plant item was a prerequisite to both successful contamination control, and effective completion within the allotted exposure limit.

It had been proposed, to use a suspended shielded work platform for elevated furniture removal within the each of the lanes, though due to the safety concerns regarding suspended load working this idea was dismissed. An alternative option was to use a mobile scissor lift platform, which was procured for deployment within the ponds. Although more expensive the dose uptake savings originally modelled with the original unit were not compromised.

The dominant source within the ponds was consistently the walls and floors themselves. Thus the scope for shielding application was limited, with time and distance being more important dose reducing practices. Randomly dispersed along the bay were localised radiation hot spots which were readily identifiable and suitable for covering with lead blanket lowered into position from the walkway. This was particularly pertinent to work in the centre bays where flask location plates, and other small items, had contact doserates approaching 10 mSv/h.

It was intended to fabricate suitable blankets that could be handled manually and the thickness built up in layers to achieve at least the Half Value Layer (HVL) for Cs-137 (8 mm lead (Pb)).

Although initially dismissed as unsuitable for the ponds environment, grinding proved a success for quickly cutting heavier gauge steel components. The occupancy within high dose rate areas was reduced by at least a factor of 5 compared to using the slower reciprocating saw. However, its application was limited to items that were not internally contaminated and the external surface had to be free of gross contamination. The cutting of pipework was expedited by cutting it into sections that were manageable and made full use of the length of the HHISO disposal container.

The use of a magnet for lifting the steel expansion joint plates reduced the dependency for an operator to carry out slinging arrangements in what was an enhanced dose rate environment. This, along with the application of local shielding, reduced the dose assessment for method statement 9 by half. The former value of 27 man mSv was then interpreted as an upper bound dose.

3. Review of Operations and Radiological Safety Management Controls

Throughout the contract there were safety reviews at project milestones, which most significantly included radiological safety management controls. A chart was developed to present percentage project task completion against percentage dose accrual for all personnel involved in the tasks. This was a crude, but effective, means of direct performance monitoring, which was very important in maintaining managerial control of each task on a day-to-day basis. A sample is presented in Appendix 2.

3.1 Elevated Dose Uptake and the ALARP Assessment

The following tasks (Method Statements) resulted in a greater dose uptake than originally planned in the ALARP assessments, the reasons being outlined below:

The dose accumulated for MS CP 9924 06 (skip location plates) exceeded the predicted dose uptake due to the environment testing necessary to reduce airborne levels to allow work to continue. This included precautionary measures such as the introduction of water spraying as a suppressant, plastic walkway matting etc.

The dose accumulated for MS CP 9924 09 (expansion plates) exceeded the predicted dose uptake due to the unscheduled cleaning of the expansion plates. This cleaning was required so the expansion plates could be placed in the HHISO for disposal, and reduced the waste classification to Low Level from Intermediate[5].

The dose accumulated for MS CP 9924 11 (removal of steam & condensate pipework) exceeded the predicted dose uptake due to shine dosage from the North Corridor; this was not taken into account during the preparation of the initial ALARP assessment.

The dose accumulated for MS CP 9924 14 (waste sorting, size reducing & HHISO loading) exceeded the predicted dose uptake. The original ALARP assessment was based on 5 HHISO being filled. There were 7 filled finally.

Appendix 2 enabled observations, and concerns, to be addressed more immediately, but could not have been completed without confidence in the use of EPDs as a reasonable indication of individual exposure. Work has been done previously to determine the accuracy of EPDs by comparison with TLD and film badge results; this was a success, and gave a high degree of confidence in the use of EPDs. As TLD and film badge results became available, the 'goodness of fit' for using the EPD could be considered.

The goodness of fit of the whole body dose measurement (EPD) to the legal dose measurements ((i) NRPB film badge and (ii) BNFL film badge) was tested using paired t-tests[8]. The null hypothesis was set up stating that there was no significant difference between the two measures, and t-values calculated. The test indicated that the null hypothesis was acceptable, showing that the two measures were not significantly different, using 95% confidence intervals (mean +/- standard error, t value: (i) 0.21+/-0.07, 3.0; (ii) 0.03+/-0.01, 2.64).

4. Review of Waste Management

An authorisation is granted under the Radioactive Substances Act (Reference 5) for the consignment of Low Level Waste (LLW) to the national repository owned and operated by BNFL at Drigg in Cumbria. As part of the LLW disposal contract a LLW characterisation document is produced detailing the radionuclide fingerprint of the waste. This is derived from detailed sampling and radiochemical analysis of the relevant ponds plant, as presented in Section 1.2 above.
The fingerprint is consistent with that expected of a wet fuel route with activation and fission products as well as actinide contamination present.
The technique used for the activity assessment of large items applies knowledge of dose rate, contamination probe and swab measurements, dimensions of the waste item, and application of the fingerprint to determine the total activity. In practice, surface dose rate measurement is the determining factor in assessing whether or not the item is likely to exceed the upper activity limit for disposal as LLW (4 GBq/t for alpha emitters and 12 GBq/t non alpha). Impirical evidence has been used as a basis for the formulation of using an average contact dose rate of 1.5 mSv/h for ponds wastestream material sentencing. A dose rate greater than this is considered indicative of potential Intermediate Level Waste (ILW), of which currently remains packaged on site awaiting construction of the ILW safestore. In addition, the dose rate associated with the item would guide decision making as to the justification for carrying out decontamination of potential ILW material to the LLW category.
Best practicable means was used to reduce the volume of waste for disposal to Drigg. The predominantly heavy gauge steel plant associated with the ponds furniture removal was regarded as unsuitable for high force compaction. Thus the only available disposal route was direct placement into a half height ISO container for subsequent grouting and disposal to Drigg. To achieve minimisation of voidage in the waste container it was essential to maximise the packing efficiency within the ISO container itself. This was made practicable by size reduction of the plant using powered cutting tools to achieve a more regular waste envelope. Critical to the decision to size reduce the de-planted items were the surface contamination levels both local to and remote from the intended cutting area. Control of resuspended airborne contamination due to vibrational disturbance was a constant issue of concern and was balanced between the speed of cut attainable, the effectiveness of the local exhaust ventilation deployed, and the decontamination and application of fixative coatings. It should be noted that flame cutting techniques had been discounted because of the conventional safety hazard in the area.

5. Project Decommissioning Review

5.1 Duration of Programme

The length of programme, from the initial planning stage onwards, created problems for dose management of the work. The initial programme of 8 months extended by 5 months due to a combination of reasons, including:

i. Extended duration for approval of method statements and safety documents.
ii. Design and approvals required for planning multi-tasked work in the ponds hostile environment.
iii. Stoppages due to excursions in the airborne radioactivity concentrations, leading to evacuations from the area.
iv. Planning to achieve dose reduction targets.

The specific milestones were achieved, however, once the project commenced at an operational level.

5.2 Dose Management

The use of EPDs for monitoring and controlling the exposure of personnel proved to be very effective, and also accurate as a legal dose indicator. The system has since been adopted across other BNFL projects where significant radiation exposure is a concern.

Use of a health physics team with extensive experience greatly aided the success of the project. Initially this was the case as the sub-contract health physics company (Matom Radiological Services Ltd) had experience of pond working and pond decommissioning at both the senior Radiation Protection Advisory (RPA) level and the operational level that guided the relatively inexperienced main contractor. The health physics supervision for the work also took on a more significant role in the early stages, and assisted by routinely briefing operatives as to the hazards and risk management involved in daily decommissioning tasks.

Although not always practical, the use of time, distance, and shielding proved to be the most significant factor reducing dose to operatives. This was most significant with the use of water spaying and ventilation of the pond lanes, and also the use of remotely positioned shield plates in the lanes.

5.3 Waste Management

The packaging of LLW containers was well prescribed within BNFL procedures. However, the dedicated team working at this task developed skills in maximising volume usage by closely monitoring the de-planting activities in the decommissioning area.

The use of dose rate measurement to identify waste streams proved to be an effective means of reducing exposure to operatives. This was also significant in reducing the double handling of high dose items and therefore exposure to operatives.

7. Effectiveness of Controls

The total dose for the project was 156 mSv which was well within the ALARP Assessment. No personal exposure exceeded the legal limit for dose whole body dose or exposure to extremities. Without doubt this was difficult to achieve, and was certainly aided by the extension to the project programme.
Another significant impact was the inability to rotate the workforce on to low dose operations, this would have greatly eased the pressure on dose management.
The objective radiological controls were extremely effective given the parameters set at the outset of the work, and were a credit to the various health physics personnel involved through out the project.

8. Acknowledgements

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9. References.

1. Waste stream Radiological Fingerprints for Trawsfynydd, BNFL Controlled Document (RDU/PSB/TRA/REP/0025/99). Issue 1. March 2000
2. *The Ionising Radiations Regulations 1999* (SI 1999/3232) HMSO 2000 UK.
3. 'Council Directive 96/29 Euratom of 13 May 1996 laying down basic safety standards for the protection of workers and the general public against the dangers arising from ionising radiation' *Official Journal of the European Communities 1996* 39 (L159) 1-114
4. *Nuclear Installations Act 1965* HMSO UK 1965 ISBN 0 10 850216 3
5. *Radioactive Substances Act 1993* HMSO UK 1993 ISBN 0 10 541293 7
6. Invitation to Tender – Trawsfynydd Ponds Furniture Removal & PWTP Deplanting. BNFL Commercial-in-Confidence 2001.
7. Trawsfynydd Ponds Furniture Removal Project Dose Uptake and ALARP Assessment. P Blott BNFL April 2003
8. *Statistical Tables for Biological, Agricultural and Medical Research.* Fisher and Yates

APPENDIX I

Method Statement 1

Cooling Ponds Walkway

i. Removal of decontamination tanks and support services.
ii. Removal of flask wash-down tank and associated equipment.
iii. Demolition of ponds offices and stores.

Method Statement 2

North Corridor

i. Removal of penstock valve guides and drive shafts including installation of scaffold tower.
ii. Removal of fuel chute flap valve.
iii. Removal of water inlet and outlet pipework.
iv. Removal of co-axial suction line to north void.
v. Retrieval of pond tools.
vi. Removal of high level demineralised water pipework and flanged pipe stub.

Method Statement 3

South Corridor

i. Removal of sections of fuel bunker and support framework.
ii. Removal of fuel chute flap valve.
iii. Removal of demineralised water pipework and flanged stub.
iv. Removal of south acceptance bay ventilation.

Method Statement 4

North Corridor

i. Removal of sections of fuel bunker and support framework.

Method Statement 5

North Acceptance Bay

i. Remove traverse trolleys (2 off), rack drives and drive mechanisms.
ii. Removal of water inlet and outlet pipework.
iii. Removal of part dismantled Robson hoist.
iv. Removal of ventilation ducting.
v. Removal of MDHSF (Magnox Debris Handling and Sorting Facility) return chute.
vi. Removal of Robson hoist drive mechanisms and control consoles from acceptance bay walkway.

Method Statement 6

Pond Lanes North AB and CD

i. Removal of skip location plates and studs.
ii. Removal of water inlet pipework to bays.

Pond Lanes South AB and CD

i. Removal of skip location studs.
ii. Removal of pipe support brackets and studs.

Method Statement 7

Pond Lanes North and South AB and CD

i. Removal of high level pipework, brackets and studs.

Method Statement 8

East Centre Bay

i. Removal of dam board storage racks.
ii. Removal of fuel flask guides.

West Centre Bay

i. Removal of fuel flask guides.
ii. Removal of demineralised water, drains and sump pipework.
iii. Retrieval of ponds tools.

Method Statement 9

Pond Lanes North and South AB and CD

i. Lift expansion joint covers and repair plates.

Method Statement 10

Ponds Walkways and Wall Areas above Ponds

i. Removal of sludge transfer pipework/system.

Method Statement 11

Ponds Walkways and Wall Areas above Ponds

i. Removal of Active Workshops and Partitions.
ii. Removal of steam and CO_2 pipework.

Method Statement 12

Ponds Walkways and Wall Areas above Ponds

i. Removal of North and South corridor penstock drive mechanisms.
ii. Removal of pond skimmers.
iii. Removal of instrument service air plant.
iv. Acceptance Bay Walkways
v. Removal of de-splittering machine control panels.
vi. Removal of North void sludge vault ventilation pipework
vii. Removal of traverse trolley control panels and acceptance bay alarm panels.

Method Statement 13

North Acceptance Bay

i. Removal of remainder of Robson hoist.

Method Statement 14

Waste sorting.

Method Statement 15

Low level waste container (ISO) loading

APPENDIX 2: Project Progress Against Dose Uptake

Activity No.	Method Statement No.	Estimated Dose (ALARP Assessment) mSv	Commence	Complete	Task Progress % Dose Uptake %	Total for Task
1	MSCP992402	22.64	29/10/03		87% 54%	12.326
	MSCP992402	4.20	17/07/03	08/07/03	100% 58%	2.409