Completion of the Decommissioning of a Former Active Handling Building at Ukaea Winfrith

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ABSTRACT

Since July 2000, NUKEM Limited has been carrying out the full decommissioning of a former Active Handling Building A59 at Winfrith in Dorset under contract from the nuclear site licence holder, UKAEA. Work has generally centred upon clearance and decontamination of the two heavily shielded suites of caves originally used to carry out remote examination of irradiated nuclear fuel elements although a number of other supporting facilities are also involved. This work has proceeded successfully to completion following extensive decontamination of the caves and associated facilities and has been followed by the recent demolition of the main containment building structure. This has permitted a start to be made on the demolition of the two heavily shielded suites of caves which is to be followed by removal of the building slab and restoration of the site.

This paper reviews some of the significant tasks undertaken during the past year in preparation for the building and cave line demolition operations. It also reviews the building structure removal and recent progress made with the demolition of the two heavily reinforced concrete cave lines. The procedure used for monitoring the concrete debris from the cave lines has had to be revised during these operations and the reasons for this and a temporary delay in the cave line demolition will be discussed in the context of the remaining sections of the programme.

This decommissioning programme has been achieved throughout by the employment of a non-adversarial team working approach between client and contractor. This has been instrumental in developing cost-effective and safe solutions to a range of problems during the programme, demonstrating the worth of adopting this co-operative approach for mutual benefit.

INTRODUCTION

One of the main aspects of nuclear research studies carried out at from the late 1960's at Winfrith Heath by the United Kingdom Atomic Energy Authority, (UKAEA) was post irradiation examination of nuclear fuel elements. In order to support the planned fuel examination programmes, UKAEA constructed an Active Handling Building A59, with two large concrete shielded suites of facilities (hot cells) and usually referred to as 'caves'. The building also contained other supporting facilities such as an equipment decontamination bay and active workshop so that the in-cave items could always be developed and maintained as required. Over the passing years the caves were used to study a wide range of differing fuel materials as well as other highly active non-fissile items.

Following the decline of the UK's nuclear industry in the early 1990s the A59 facilities were declared redundant and in the year 2000, NUKEM Limited (NUKEM) was awarded the contract by UKAEA to clear, decontaminate, decommission and demolish the whole building. This was in support of UKAEA's mission, which is to carry out environmental restoration of its nuclear sites and to put them to alternative uses wherever possible. Latterly, a new body, the Nuclear Decommissioning Authority (NDA), has become responsible for managing the UK decommissioning legacy and since 2004 UKAEA has been contracted to the NDA to deliver decommissioning work at Winfrith and other UK sites. The decommissioning strategy, mainly but not exclusively centred on the cave lines, was prepared by NUKEM at the tendering stage and can be linked together to form a set of nine of specific phases:

- Clearance of redundant equipment, benching and services
- Remote cleaning to target dose rate levels to permit man entry
- Man entries to complete the removal of all residual items and carry out surface decontamination to low levels
- Removal of mobile shielding window units and encast ventilation ducting
- Final decontamination of all internal cave surfaces to de-minimus levels
- Clearance of all remaining out-of-cave facilities including decontamination bay and overhead cranes
- Demolition of the building structure
- Demolition of the two cave line structures
- Removal of the building slab and encast floor storage hole liners and other items

In four earlier papers, (1-4), completion of the decommissioning was reported on six of the nine phases of the programme, noting that for sound technical reasons the building structure was to be fully decontaminated and demolished ahead of the two cave lines. This paper covers the progress made over the last year with two of the remaining phases of the programme. It highlights some of the problems that have been experienced and the means by which they were overcome which may be useful to others concerned with decommissioning large nuclear facilities. This a dynamic programme and currently the building structure has been completely removed and the demolition of the two cave lines has reached the halfway stage.

UPDATED DECOMMISSIONING OPERATIONS

The latter stages of the A59 decommissioning operations were extremely diverse covering the removal of all unwanted items, the steady dismantling and removal of basic services and the preparation of the two cave lines for demolition. The key steps taken during this sixth phase of operations were:

- Preparation of the cave lines for demolition
- Demolition of the pressurized suit facility
- Removal of the decontamination bay & active effluent system
- Decontamination and monitoring of all building surfaces

There were many additional tasks such as the removal of the personnel monitoring units, the clearance and relocation of staff from the first floor offices, the removal of sections of the above-ground active drainage system and finally the isolation and removal of the electrical and water supplies to the building. Here the planning and execution of the programme had to be carefully controlled as basic services were gradually removed, the areas of the building cleared and redesignated ahead of demolition.

<u>Preparation of the Cave Lines for Demolition</u>

Each cave line had been provided with several hundred steel lined penetrations through the walls and roof to allow the provision of in-cave services fed from external sources or for introduction of items via large diameter roof ports. It proved impossible to completely decontaminate these encast steel tubes and after sealing their internal surfaces with a tie down coating, each was closed using steel plates bolted or welded into position. This sealed the tubes to prevent any release of contamination and it was known from earlier tests that each unit could be recovered intact during demolition for disposal as Low Level Waste (LLW), (3). After the cave lines had been internally decontaminated to low levels using a variety of abrasive techniques, the internal surfaces were painted with a distinctive colour waterproof paint to seal them and indelibly mark these materials for later identification during demolition. This was done because the presence of residual radioactivity inside the steel liner tubes and other parts of the cave floor raised the in-cave background dose rate so that it could not be determined that all surfaces were clean by monitoring alone. Low levels of loose contamination were then confirmed by taking

Figure 1: Removal & dismantling of cave line modular shielding blocks with the north cave line on the right and south cave line on the left looking west

surface swabs and counting them in a low background position. The end point was reached after a series of decontamination sweeps over all internal surfaces showed that no further reduction in mean dose rate could be achieved.

During the decommissioning of both cave lines the zinc bromide window units had been removed together with a total of eight 40Te mobile shielding blocks. These were modular items constructed from specially made concrete blocks assembled into a complete unit and capable of insertion into the cave wall at fixed positions, Figure 1. At an earlier stage these units had been removed, dismantled and the materials decontaminated largely for disposal as exempt waste. Since the main building structure was to be demolished first, the wall openings at each operating face and at each end of the caves had to be closed to seal the facility, achieved by closing the openings with concrete block walls.

Demolition of Pressurised Suit Facility

The pressurised suit facility (PSA) had been used to handle and process alpha contaminated materials and despite being decontaminated the residual levels on surfaces were too high to meet the conditions for exempt release. It was decided to demolish this free standing facility in-situ and remove the concrete debris as LLW ahead of building demolition. An electrically operated BROKK 330 unit was used to carry out the demolition of the mainly brick walls and precast concrete beam roof, the machine being operated remotely with considerable advantage, Figure 2.

Figure 2: Demolition of pressurised suit facility using BROKK 330 unit

A small gas-powered 'Bobcat' unit was used to recover the waste materials which were loaded directly into ISO containers for disposal. The use of the remotely controlled BROKK and the gas-powered 'Bobcat' allowed other operations to continue in the building without significant disruption to other work. At the end of this process only a small amount of alpha contaminated steelwork was left in place and all surfaces on these materials were painted to seal them and to aid later identification for recovery and disposal as LLW during demolition.

Removal of the Decontamination Bay and Active Effluent System

Throughout the decommissioning process the decontamination bay was used to clean a wide variety of items to enable them to be disposed of as exempt waste or LLW. The timing of removal of the various facilities within the facility was crucial to maintaining this capability for as long as possible ahead of the demolition. The cleaning cabinets were removed first as the emphasis changed to simple disposal of items with low levels of contamination. Then the remaining units such as the steam cleaners and the two presses used to compact waste were removed along with a large machine saw. One press and the saw were retained for further use with size reduction of LLW items recovered during demolition but all of the rest of the items were disposed of as LLW.

The final steps in this process were to strip all surfaces to remove contamination. In the gridded area where the main decontamination operations were undertaken, removal of the tiles from the sump revealed evidence of contamination spillage. Ultimately, removal of a second, earlier layer of tiles showed that there was still contamination in the base slab and so these surfaces were sealed and covered by sufficient fresh concrete to provide a level surface in this area. This result was not entirely unexpected and demonstrates the type of problem to be addressed later when the slab is removed. All other areas of the decontamination bay were successfully decontaminated to the specified level to be acceptable for demolition.

Within the decontamination bay there were several pipe runs below the floor leading out to an external set of sump tanks with pumps to transfer the effluents to the site active effluent treatment plant. After removal of the primary pipework, the secondary pipework was pressure washed in the established manner and the entry points in the slab sealed with expanded foam. The external tanks and pumping plant has been retained and as a result of the building demolition, has been provided with a replacement power supply from an alternative position on the site.

Decontamination and Monitoring of All Building Surfaces

During the latter stages of the building clearance, the final decontamination and monitoring of all internal building structure surfaces was undertaken. This was necessary so that the demolition contractors could remove the building structure as exempt, potentially recyclable materials. Accordingly, a protocol for the monitoring was established and approved by the client’s Radiation Protection Advisor ahead of the process commencing, (5). The procedure agreed was to indelibly mark all surfaces throughout the building into 1m x 1m squares, each with a unique reference code number. Each area was then monitored for activity above background following standard techniques. This included the external surfaces of the two cave lines. Once surveyed, the results were reviewed, and any required decontamination and further monitoring was carried out. In addition, some reassurance monitoring was carried out following completion of all decontamination and remediation works in the building, to confirm that areas were not re-contaminated. As may be imagined this was a long process involving many hundreds of man hours to accomplish.

The process was undertaken initially in areas that could be cleared and closed off to allow monitoring without any risk of subsequent recontamination. Later, as the work progressed, the operations spread throughout the supervised areas close to the building exit point where the two personnel monitoring units were located. Progressively more areas of the building were reduced in classification from ‘Controlled’ to ‘Supervised’, allowing the monitored areas to expand until only the decontamination bay remained operative. The final act was to decontaminate and monitor all the surfaces including the roof in this area to complete the task. After reassurance monitoring had shown all surfaces were clean, a list of items with fixed contamination on them was drawn up. This included all five building cranes, the PSA steelwork, some high level window sills in the decontamination bay, the inlet plant room floor where there were historic traces of tritium contamination and a number of other small identified items. Special arrangements were made to identify and recover these materials during the course of the subsequent demolition. At this point the offices were evacuated, all services isolated remotely and the building declassified and handed over to the demolition contractor.

BUILDING DEMOLITION

The building structure was demolished ahead of the two cave lines as the latter provided considerable structural support for the building roof. Before the demolition work could be undertaken, four specific tasks had to be completed. This involved the erection of safety fencing around the whole demolition site, the removal of two sets of emergency exit staircases, the demolition of a small adjacent storage building and finally, the removal of the concrete asbestos cladding from many external surfaces.

The asbestos cladding was removed by a specialist contractor who provided all the necessary access and safety equipment required to carry out this important task in a safe, efficient and timely manner. Access to the very high areas of the building was challenging due to the presence of soft ground around parts of the perimeter and the need to lower the asbestos sheets to ground level for disposal. The solution adopted was to construct a temporary hard standing around the perimeter of the building which allowed the use of a large two man hydraulic, elevating platform constructed for such purposes. The sheets were first sprayed with a tie down coat to prevent release of any asbestos dust and fibres, allowing the holding features to be cut away with an electric disc cutter. Insulation fibre between the inner and outer skins of cladding were also recovered and disposed of along with the cladding sheets. The specialist contractor also completed a Type 3 asbestos survey and recovered all identified asbestos contaminated materials. All recovered materials were monitored for radioactivity, having remained in place for over 40 years since construction. Only in one small area was radioactivity detected on the insulation materials and these were wrapped in polythene and set aside for disposal as low level waste. Somewhat surprisingly, none of the adjacent asbestos cladding sheets was found to be contaminated.

The building demolition was also undertaken by a specialist contractor capable of provision of all necessary equipment to carry out the task. The contract included the removal of the 30m high building ventilation stack, the five heavy building cranes and the inlet ventilation plant. Other special requirements were included as noted in more detail below. The main plant comprised a steel shearing head mounted upon a 50 Te tracked hydraulic excavator. Smaller plant of a similar type and features was used to size reduce the heavy steel columns and other items recovered as the contract progressed. An impression of the starting position once the cladding had been removed is shown in Figure 3.

Figure 3: View of the building after removal of the concrete asbestos cladding

Before the contract started, the operatives were briefed carefully about working with the site-based health physics surveyors who were to monitor items and debris selectively to ensure that no radioactive materials were incorrectly consigned. As noted above, the whole building structure and internal surfaces had previously been carefully monitored for radioactive contamination and with the clear exception of a few well identified items, was pronounced clean and available for unrestricted demolition. The importance of this pre-requisite to the demolition cannot be over-emphasized. Not surprisingly, all the building cranes were known to contain small amounts of fixed contamination at various positions and it was agreed at the outset that these could be removed when the items were removed to ground level, hence removing some significant industrial hazards. Some items of structural steelwork in the former pressurized suit facility (PSA) were also known to contain small amounts of fixed contamination and these were clearly identified by painting them in a bright colour so that they could be set aside during the demolition. Most of the other contaminated items comprised small sections of steel, pipes and so on and a manifest of these items was taken for recovery during the following demolition process. It is pleasing to report that all these items were safely recovered for disposal as LLW as the building was demolished.

The first operation concerned the demolition of the inlet plant room floor, which was about 0.3m thick and comprised an area about 6m x 10m. Due to past operations with heavy water re-constitution this floor had become contaminated with Tritium. Later, this room was cleared of the original plant and the space used to house a new inlet air heating and ventilation plant. This plant was first removed using the large excavator and size reduced at ground level for disposal. This permitted the floor to be demolished with the debris falling onto the concrete floor below from which it was recovered for disposal into ISO freight containers as LLW.

Building demolition then proceeded up to the point where it became necessary to remove the original building ventilation stack located towards the centre of the facility. The internal surfaces of this item could not be monitored to any extent before demolition and it was suspected that there would be traces of contamination present. Due to the height and location of the stack above the flat building roof and the need for a controlled means of recovery, it was decided to remove it in three sections using a suitable crane. Access to the stack to provide lifting points and to cut it into 2-3 Te sections was provided from a man-access cage suspended from a second crane. Holes were then cut in the stack using an oxy-propane burner to allow steel lifting chains to be attached for the removal operation. The cradle was then lowered to a suitable position to allow the stack to be cut around its circumference for the first lift. By these means the stack was safely recovered in three sections, which were laid down onto polythene sheets inside an external supervised area compound. Evidence of internal contamination was found in the stack, which was either removed by swabbing or cut away using standard techniques for disposal as LLW. Of the ~9Te of steel debris recovered, >90% was disposed of as exempt material, a very pleasing outcome.

Most of the remaining building demolition went ahead without any great difficulty including removal of the five overhead travelling cranes. These units had been prepared for demolition by final location close to their end stops which were then removed to allow them to be pulled down to ground level with the main demolition machine. Each unit was then monitored to confirm the spots of fixed contamination were still present and they were then removed with the machine to a prepared location where size reduction and disposal operations were undertaken. Once again the ‘Petrogen’ gas cutting system was used to size reduce the large sections of the various cranes to permit easier monitoring and to minimise the risk of releasing contamination into the environment. In some cases local decontamination was effective in removing radioactivity such that the debris could be disposed of as exempt material. In all about 90% of the waste by weight was disposed of as recyclable material with 10% loaded into 200 litre drums for disposal as LLW. Throughout these operations, health physics surveyors were present to supervise the operations and subsequently to monitor the ground to ensure no contamination or contaminated materials remained.

As the demolition came to an end, structures were being removed close to the two cave lines. The building roof had already been removed and operations centred upon demolition of the single-skin, brick infill walls between the vertical columns immediately above the cave walls, running upwards. The powerful demolition machine removed these readily but a new problem then emerged. The two cave lines had each been provided with a single skin brick-walled ‘transfer chamber’ at the west end into which the in-cave hoists could be driven for repairs and maintenance. It was intended to use these two ‘transfer chambers’ to provide a means of ventilation of the cave lines during demolition but unfortunately the heavy machine accidentally damaged parts of the walls of each during the work on the structures located above. As a result, after stopping work to carefully consider the options, it was agreed to complete their demolition and then block up the cave lines at the west end to provide a full enclosure as originally intended. The problem with this unplanned development was that most of the materials from the two transfer chambers had to be placed into ISO freight containers for disposal as LLW as both were internally contaminated at a relatively low level.

Operations then concentrated upon the monitoring and disposal of the accumulated steel and concrete debris from the building structure. This proceeded steadily and within two weeks the whole area had been cleared with the vast bulk of the steel debris being removed for recycling. The brick and concrete debris was also collected up into lorries and taken to the dedicated storage area on-site where it will subsequently be size reduced to provide in-fill material. All materials transported off site or to the storage area was also subjected to confirmatory monitoring in the site based 'Exploranium' facility, all loads passing this further test. It is estimated that about 105 Te of LLW was generated during these operations, mainly from the disposal of the plant room floor and the transfer chamber brickwork (86Te) but also including debris (19Te) from the building cranes.

CAVE LINE DEMOLITION

Ventilation Systems and Discharge Stack

In preparation for the demolition of the two cave lines located upon the building concrete slab, a number of supporting operations had to be undertaken. It had been agreed that during demolition both cave lines would be provided with a ventilation system drawing air inwards via a wall port in the west end whilst carrying out the demolition from the opposite east end. The intention was to minimise the risk of release of any residual radioactivity from the caves into the environment during demolition. To support this ventilation system a new discharge stack had to be constructed together with a monitoring facility so that the actual discharges could be determined and constrained within specified limits set for the site as a whole and regulated by the Environment Agency, (EA). Fuller details about the development of the ventilation system and its approval for use lie outside the scope of this paper.

Additionally, a ventilated low level waste handling facility had to be provided to receive and size reduce the many hundreds of internally contaminated steel through tubes located in the cave line walls and roof and other contaminated steel items recovered from the structure as demolition advanced. A commercial HAKI tent about 7m x 14m in area with a ridge roof rising to about 7m was used to provide this facility, being located at the north-west part of the slab. Each end was enclosed with an electrically operated roller shutter door for access by fork lift trucks and other equipment. A diesel generator was used to provide power to this facility to operate the lights, doors, air mover, a power hacksaw, hydraulic press and other tools. The air mover was also to be attached to the new discharge stack so the new site based ventilation system comprised an air mover for each cave line plus a third to support ventilation of the HAKI tent. In this instance a horizontal stack arrangement was adopted and each air mover connected to the stack was fitted with a double bank of HEPA filters to entrain any contamination generated during demolition or waste handling operations. One of the key requirements for the discharge stack was the installation of an isokinetic discharge monitoring system. This system draws air via a calibrated nozzle located in the stack through a particulate filter to entrain any solid particles that might contain radioactivity. Arrangements were provided to adjust the sampling airflow such that isokinetic conditions could be maintained when one, two or three air movers were operative.

North Cave Line Demolition

Before demolition of the two cave lines could commence, the area around the two cave lines was surrounded by an inner safety barrier and designated a 'controlled area'. Access to this area was provided through a cabin at the north east corner of the site provided with a change barrier, two personnel monitoring units and hand washing facilities. Operatives were required to wear coveralls inside this area together with other safety equipment such as hard hats, safety shoes and glasses.

The first stage of demolition required the enclosure built at the east end of the North Cave Line (NCL) to be removed to provide access to the ventilation system located at the west end upper wall. Before operating the air mover a primary filter unit was located over the 50cm diameter steel extract tube to remove the worst of any particulate dust at this position. The air mover was then started to provide an inwards airflow to the cave line during demolition. At this point demolition at the extreme east end commenced. As explained earlier, it had not been positively established that the interior surfaces of the cave line were uncontaminated. Initial demolition thus proceeded slowly and the concrete debris monitored in a low dose rate position away from the cave line revealed almost no contamination even on the internally painted surfaces. Waste monitoring was extremely thorough and all materials were subjected to 100% surveillance. However, once operations reached the boundary between the first two of the seven cave units, increasing traces of contamination were detected on internal surfaces during the monitoring and a temporary halt was made to assess the position. The demolition was amended at this point with the machine used first to try to break away the internal surface layers to allow these to be recovered, checked for contamination and if appropriate loaded into 200 litre waste drums for disposal as LLW. Two other changes were made at this stage; a commercial water misting unit was provided to assist with damping down the dusts created at the demolition location and two surface tables were constructed using wooden planks supported from a steel scaffolding frame to assist with the debris monitoring process. The recovered wastes were then placed by machine onto these tables for hand monitoring at a convenient height using sensitive beta/gamma probes.

Demolition restarted and remained slow owing to the high quantity of steel reinforcement present in the structure and the constant need to monitor by hand all the waste recovered from the structure. Work concentrated upon the larger rocks of concrete and a decision was taken to ignore for now the smaller 'fines' owing to the time required to monitor this manually. One particularly difficult problem experienced here was the need to carefully recover the steel through tubes from the structure in an undamaged condition. However, due to the skill of the machine operator, this was successfully accomplished and the tubes were set aside for size reduction and disposal as LLW in the HAKI tent. An additional problem concerned the need to recover both steel liner tubes and a series of steel plates from the cave roof area. This was again achieved successfully, the items being lowered into the bucket of a second machine strategically placed close to the demolition position to 'catch' the item as it became free. Some entrained contamination was anticipated on the roof plates due to the original overlapping, unsealed arrangement and this was subsequently confirmed during the monitoring. However, using a 'Blastrac' shot blasting machine and cyclone vacuum system inside the HAKI tent, most of these plates were subsequently decontaminated for exempt disposal. When the second cave unit had almost been completely demolished, operations were halted to allow the smaller, and predicted to be lesser contaminated South Cave Line to be completely demolished first.

South Cave Line Demolition

The South Cave Line (SCL) was prepared for demolition as for the NCL and the ventilation system energized once the primary filter had been installed at the west end. Operations proceeded quite steadily but almost from the start evidence of low levels of surface contamination was detected on the inner wall debris. The machine operator soon became quite adept at stripping away the inner surface layers, carefully avoiding the places where the steel penetration tube flanges and other similar items were present. Once this debris had been cleared as LLW, the machine proceeded with the main wall and roof demolition, the waste concrete being removed and accumulated in an external pile to allow time for 100% monitoring to be undertaken. Throughout this period the water mist unit was deployed close to the demolition site to assist with dust suppression and a water hose was also used to apply more water to the locality, especially during periods of high wind when dust control became more problematic. All the steel penetration tubes were successfully recovered intact as well as the inner frames of the original zinc bromide windows. Many of these latter frames were found to be contaminated and were thus size reduced in the HAKI tent for disposal as LLW. Over a period of about 15 working days the whole cave line was demolished as can be seen in Figure 4.

Throughout this period the monitoring of the cave line debris continued but it became clear that a more automated method was required to cover the ~600 Te of debris that had by now been accumulated. Just before the cave was completely demolished the air mover

Figure 4: Demolition site showing HAKI tent and remains of north cave line plus the ventilation system and horizontal discharge stack

was shut down and the system removed from the end wall of the cave to allow this part of the structure to be demolished to complete the operation. The air mover was subsequently withdrawn from the area, decontaminated and made ready for operations elsewhere.

Site Monitoring and Revision to Debris Monitoring Procedure

Once the base slab had been cleared of the main debris from the SCL, and the accumulated concrete debris had been moved and covered with sheets, demolition operations were halted. Discussions took place with NUKEM and UKAEA specialists to devise an automated method of monitoring that would deliver an improved schedule performance whilst still maintaining that all radioactive waste was assigned correctly. In order to provide a high level of confidence that the debris was non-contaminated, it was resolved to crush it to <100mm cube so that it could be placed for monitoring into a series of concrete troughs 2.5m wide, 15m long and 0.1m high. Each trough will be loaded with crushed debris and leveled to provide a constant cross section ready for monitoring with a 75mm x 75mm sodium iodide crystal connected to an Electra rate meter. After monitoring, any areas identified holding debris lying above the agreed level will be removed for disposal as LLW.

This system has been accepted by UKAEA for the monitoring the remaining concrete debris from the cave line demolition and will also be used later to monitor the concrete debris from the base slab. All the accumulated materials have now been crushed to the required size and one of the advantages of proceeding with this method is the fact that the debris has ultimately to be size reduced as part of the terms of the contract. Operations using this monitoring system are well advanced and appear to be working well. All materials after processing are subjected to reassurance monitoring in the site based 'Exploranium' system.

The other issue that has been addressed concerns the need throughout demolition to minimise the spread of dust from the site into the environment, particularly following the detection of traces of contamination on the inner cave surfaces. The cessation of demolition of the SCL provided an opportunity to check the demolition site for evidence of radioactive contamination. These surveys showed that although there was evidence of the spread of dusts there were almost no traces of contamination. However, it was decided that it would be prudent to provide an enclosure over the remainder of the NCL to ensure there was better control of dusts during demolition. This enclosure is to be large enough to allow the demolition machine to operate inside with an open end to the east to allow for removal of fumes and to allow the debris to be removed in a fully controlled manner. A water mist system will be provided at the open end to damp down any dusts that might reach this position. Work is currently in progress on the construction of this enclosure, made using a scaffolding framework covered by synthetic sheeting materials.

FORWARD PROGRAMME FOR COMPLETION

In the coming months the completion of the enclosure will enable the remaining five caves of the NCL to be demolished in a controlled manner, leaving just the base slab for removal and remediation of the underlying soil. Throughout this period the accumulated SCL concrete debris will be monitored and any active materials set aside for disposal as LLW in 200 litre drums. The new debris from the NCL demolition will likewise be crushed and treated in a similar manner, there being another ~1000Te to process in all.

The remediation task has recently been added to the contract scope and plans are well advanced to enable this to be undertaken. The plan is to remove the most active remaining items from the slab first, being sections of the active ventilation ducting and filter pits in the area between the two cave lines. This will be followed by the removal of the floor storage holes and finally the shallow active drain pipes. This will then allow the other sections of the base slab to be steadily removed, taking off the ~0.35m deep high density concrete first followed by the underlying ~1m deep low density concrete to expose the underlying soil. The surveillance of the base slab will commence using moderately sensitive instruments to identify those areas where traces of fixed contamination are present. As the excavations become deeper progressively more sensitive instruments will be deployed, probably from a mobile elevating work platform (MEWP) capable of accessing excavations up to 7m deep. On the basis of data already available, there are several sites on the slab where earlier local excavations showed rising dose rates and all these sites will need to be investigated during this process. The outcome of these operations will form part of a subsequent paper.

LESSONS LEARNT

Throughout this large decommissioning project some important lessons have been learnt from the experiences gained, (1-4). Some of these have already been taken into account during NUKEM’s decommissioning of another large facility on the Winfrith Site, (6). However, the experiences of the last year have provided NUKEM with one of the first opportunities to carry out the controlled demolition of what had been a very contaminated building. The decision to monitor 100% of the building internal surfaces for contamination was challenging but greatly benefited by establishing at an early stage with the company and client Radiological Protection Advisors (RPAs) a clear protocol to be utilised, (5). The requirement for a small programme of later confirmatory monitoring of selected areas of the building was a major means of establishing confidence in the outcome of the overall process. The fact that the building structure was then demolished so speedily and without incident lends significant support to this view. The procedure is strongly recommended to others engaged in similar operations.

The second major lesson learnt lay with the need to obtain better information on the decontamination state of the two cave line internal surfaces at an earlier stage than at the start of demolition. Some concrete cores had been cut from the inner faces of both cave lines and analyses revealed no evidence of fixed contamination on the internal surfaces or within the depth of the structure. There was thus reasonable confidence that the internal decontamination had been completed successfully but events subsequently revealed areas where residual fixed contamination was still present. In the event, the complete South Cave Line was demolished efficiently within a period of 15 days. However, since the residual contamination levels could be higher on the North Cave Line inner surfaces, the completion of this demolition was delayed to allow the provision of a temporary enclosure around the structure. This enclosure will provide better control on the demolition dusts and any possible contamination to ensure that negligible amounts reach the environment during this process. This delay could have been reduced had this problem been recognised at an earlier stage, allowing time to design the structure now judged prudent to provide.

And finally, the means of monitoring the concrete debris from the cave lines could have been developed at an earlier stage, particularly if the true state of the internal surfaces had been appreciated. Nevertheless the method devised is robust, has been accepted by the client’s RPA and is based upon sound monitoring procedures used within the industry. The fact that crushing of the concrete debris to <100mm size is a requirement of the contract is an added benefit of the chosen protocol and significant progress has been made on processing the materials concerned.

CONCLUSIONS

Over the past year the Building A59 structure has been fully monitored to an agreed procedure to confirm it was clean and ready for demolition. Subsequent demolition proceeded routinely without incident to include removal of the central 30m high ventilation stack and other redundant plant. More than 95% of all debris was removed as exempt or clean waste, showing the effectiveness of the agreed monitoring protocol adopted. About 50% of the two cave lines have been demolished to date, particularly the South Cave Line removed over a 15 day period. Some valuable lessons have been learnt during this overall process and the employment of a non-adversarial team working approach between client and contractor throughout has been instrumental in developing cost-effective and safe solutions to a range of problems during the programme.

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