Decommissioning of the Secondary Containment of the Steam Generating Heavy Water Reactor at Ukaea Winfrith

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ABSTRACT

The Winfrith SGHWR was a prototype nuclear power plant operated for 23 years by the United Kingdom Atomic Energy Authority (UKAEA) until 1990 when it was shut down permanently. The current Stage 1 decommissioning contract is part of a multi-stage strategy. It involves the removal of all the ancillary plant and equipment in the secondary containment and non-containment areas ahead of a series of contracts for the decommissioning of the primary containment, the reactor core and demolition of the building and all remaining facilities. As an outcome of a competitive tending process, the Stage 1 decommissioning contract was awarded to NUKEM with operations commencing in April 2005.

The decommissioning processes involved with these plant items will be described with some emphasis of the establishment of multiple work-fronts for the production, recovery, treatment and disposal of mainly tritium-contaminated waste arising from its contact with the direct cycle reactor coolant. The means of size reduction of a variety of large, heavy and complex items of plant made from a range of materials will also be described with some emphasis on the control of fumes during hot cutting operations and establishing effective containments within a larger secondary containment structure.

Disposal of these wastes in a timely and cost-effective manner is a major challenge facing the decommissioning team and has required the development of a highly efficient means of packing the resultant materials into mainly one-third height ISO containers for disposal as LLW. Details of the quantities of LLW and exempt wastes handled during this process will be given with a commentary about the difficulty in segregating these two waste streams efficiently.

The paper sets out to demonstrate the considerable progress that has been made with these challenging decommissioning operations at the SGHWR plant and to highlight some of the techniques and processes that have contributed to the overall success of the process. The overall management and control of safety during all aspects of this challenging contract are major features of the paper, greatly assisted by the adoption from the outset of a non-adversarial team working approach between client and contractor. This has greatly assisted in developing safe and cost-effective solutions to a number of

problems that have arisen during the programme, demonstrating the worth of adopting this co-operative approach for mutual benefit.

INTRODUCTION

The Winfrith Steam Generating Heavy Water Reactor (SGHWR) was constructed as a prototype power generating plant in the mid-1960s at the new UKAEA nuclear research establishment at Winfrith Heath in Dorset. The plant was designed to include a direct cycle steam turbine and alternator capable of generating 100 MW(e) connected to the national grid.

This plant commenced operation in 1967 and operated mainly as an experimental reactor until the late 1980s when the main fuel irradiation programme was completed. After this time it became an important source of electricity generation in the southern sector of the national grid. In 1990, after concerns had been raised about the safety of some parts of the plant, the reactor was shut down permanently and decommissioning operations commenced.

As nuclear site licence holder and operator of the site, UKAEA has a duty to manage the restoration of the Winfrith Site and as part of this process is managing the full decommissioning and demolition of the SGHWR. Following recent government changes, financial authorisation for the decommissioning of former UKAEA sites has passed to the Government’s Nuclear Decommissioning Authority (NDA) which now provides the funding for ongoing programmes.

In 2005, after a competitive tending process, NUKEM was awarded a contract to carry out the Stage 1 decommissioning of the plant. This involves the decommissioning of all the ancillary plant in the reactor’s secondary containment and non-containment areas such that several other contracts could be awarded subsequently to decommission and remove the reactor core and the whole containment building.

This paper describes the work carried out by NUKEM on the Stage 1 decommissioning operations since contract award in April 2005 with particular emphasis on the range of tasks carried out using a variety of equipment items and decommissioning techniques that may be of value to others carrying out similar work. (e.g. References 1-4). The work involves the decommissioning of some very large items of equipment such as the turbo-alternator, de-aerator vessel, condenser, feed heater cell, emergency cooling water vessels, refuelling machine and rotating shields and other similar plant items from a power generating plant.

Other issues will also be covered including the treatment and decontamination of tritiated waste items and the employment of a non-adversarial team working approach to the tasks by both client and contractor, which has been of great benefit in maintaining the momentum of operations.

DESCRIPTION OF THE SECONDARY CONTAINMENT OF THE SGHWR

The SGHWR reactor and turbo-generator are located along with all main items of ancillary plant inside a single large building to keep the plant compact and to provide a secondary containment for the facilities. The reactor is housed inside a concrete enclosure at one end of what is termed the turbine hall, the concrete walls providing biological shielding when the plant is in operation and to provide the main primary containment for this reactor. The reactor design is one with pressure tubes within which sit the nuclear fuel elements, generating heat which is passed to light water running upwards through the tubes under the impetus of powerful circulation pumps located within the primary containment. This water boils and with the steam is led off to two steam drums where the latter is separated from the water and fed directly to the steam turbine. The water and the condensate from the turbine are returned to the bottom of the reactor core by the circulation pumps. The reactor used heavy water (D_2O) as a moderator contained around the whole core inside an aluminium calandria. The moderator required some cooling and purification facilities located in various plant rooms. Although on-load refuelling was originally intended, the fuel elements were actually exchanged off-load by a second refuelling machine located above the rotating shields upon which the original refuelling machine was mounted.

The secondary containment holds almost all of the ancillary plant required for a power reactor with a few additional items outside this envelope where there is no requirement to provide any containment. The turbo-generator is one of the main items and sits immediately above the condenser which takes most of the exhaust steam. Here it is cooled by a secondary water supply fed in by powerful pumps and circulated through two sets of external cooling towers.

Other major plant items comprise the de-aerator vessel, the feed heater cell, the two suppression chambers, refuelling machine and rotating shields, emergency cooling water vessel, the 90 and 40 Ton emergency water tanks, plant rooms and the main 60Ton overhead travelling crane. The main function of these items will be outlined when their decommissioning operations are discussed later.

DECOMMISSIONING OPERATIONS BEFORE CONTRACT START

Since the SGHWR was shut down in 1990, considerable work has been accomplished by UKAEA that lies outside the scope of this paper. In particular, all the fuel assemblies were discharged from the reactor and returned to British Nuclear Group (BNG) at Sellafield for reprocessing. This allowed the fuel storage pond to be cleared of all redundant items and then drained in a controlled manner to allow the surfaces to be decontaminated down to de-minimus levels, (Reference 5, 6). This work was carried out by staff that now form part of the NUKEM team at Winfrith and the success of the operation involving some novel concepts was a factor that assisted the Company to win the current Stage 1 decommissioning contract.

Much of the plant was then drained of cooling water and lubricating oils, the heavy water was removed and sold for recycling by UKAEA and many of the offices were emptied and prepared for decommissioning. This rationalisation included total clearance of a number of 'pipe corridors' where many of the major liquid conveyance facilities for the plant were located.

The original plans for the remediation of the various nuclear facilities on the Winfrith Site were based upon leaving the reactors alone for many years whilst the core components were allowed to decay to much reduced activity levels. Thus, these original plans only permitted limited further decommissioning to be undertaken, which more recently included demolition of the two sets of external cooling towers as well as the main building ventilation stack and the 'roundhouse' office block located at the front of the site. However, with the creation of the Nuclear Decommissioning Authority, the plans for remediation of the site have been substantially advanced. This has lead to the development of revised plans for the SGHWR decommissioning with Stage 1 due for completion by 2006 and the remainder by about 2015.

After the award of the Stage 1 decommissioning contract to NUKEM, work commenced in earnest in May 2005 and is progressing steadily, being currently close to the end of the agreed timescale for completion. The work is very intense and this paper sets out some of the challenges that have been met and overcome throughout this period.

CURRENT DECOMMISSIONING OPERATIONS

The Basic Plans for Decommissioning

The decommissioning of a complex plant such as the SGHWR involves many hundreds of items and plant rooms throughout the secondary containment building. The plant is actually arranged on many different levels within the facility in order to get everything into a relatively small space. By way of illustration, the ground floor of the building is located at Level 4 with six more levels rising upwards to Level 10 at the top of the plant with a height differential of ~20m. In contrast, a significant part of the reactor and primary circuit plant is located at up to 13m below ground level.

It can immediately be appreciated that to decommission such a wide range of plant items, some comprising really large and heavy units all located at a range of different levels over a 20m height span requires considerable ingenuity and also an ability to work on many fronts. The other factor to consider is an ability to create space between work fronts to ensure operator safety and the need to size reduce items, monitor them and dispose via the appropriate waste stream.

At the tendering stage, NUKEM established a procedure that would be adopted for the decommissioning, setting priorities for the plant removals split up between a number of Task Managers and their support teams. One major issue that had to be taken into account was the prevalence of tritium contamination in and on many items as a result of their exposure to tritiated steam and water during the plant's working life. This meant that these items either had to be disposed of as LLW or, where possible, were to be shot blasted in order to try to reduce tritium contamination levels to below 0.4Bq/g, under the SOLA Exemption Order (1986) leading to disposal as an exempt material. The impact of these matters on waste disposal arrangements will be mentioned later. In any event, the decommissioning contract has incentivised NUKEM to minimise the volume of LLW generated below a stated amount in cubic metres with financial rewards or penalties if this is reduced or exceeded.

In the sections below, the decommissioning of a number of major items of plant is described together with the various challenges and solutions devised to enable these pieces of equipment to be size reduced, removed and disposed of to an appropriate waste route. These have been selected to cover a range of challenges with minimal duplication

Establishing Multiple Work Fronts & Hot Cutting Facility

The SGHWR reactor plant is housed inside a relatively small volume and the need to complete the Stage 1 decommissioning over the relatively short period of 18 months required the establishment of multiple work fronts from the outset. Operations were thus initiated on five major work fronts, each utilising a small team of 5-10 operatives under the leadership of a Task Manager to include a supervisor and health physics monitor. Some specialist sub-contractors were provided at this time and throughout the contract when required. Examples of this include specialist asbestos removal contractors and a team of diamond wire sawing operatives. By these means a series of work fronts were quickly established working on the steam turbine and turbo-alternator, de-aerator, refuelling machine, condenser and the external suppression chambers. Additionally, the opportunity was taken to progress the stripping of the ~200 individual plant rooms located within the secondary containment, each holding a variety of redundant plant items. The separation of these teams and the control of the waste streams generated was a major task itself requiring a dedicated team of operatives and facilities. The need to keep the waste materials moving by relocation, size reduction and packing into ISO containers for disposal as LLW or after monitoring for recycling/disposal as exempt materials became an essential aspect of the whole programme. In support of this objective loading positions for ISO containers were established at the turbine floor level with ready access via the overhead crane to a vehicle/trailer loading bay located lower down the plant, leading to their removal from the plant via an airlock.

Since many of the items to be dismantled were large and heavy, it was inevitable that hot cutting techniques would be utilised from the outset. However, the secondary containment was fitted with fire alarm sensors and close control of the fumes from hot cutting immediately became an important issue to avoid having to stop work due to the triggering of these alarms. As a result, a hot cutting facility was created within the original Emergency Cooling Water (ECW) Tank Room after the size reduction and removal of this item. This central area was capable of receiving large items of up to 4m x 3m in dimensions and weighing many tons, the materials being loaded through a roof hatch via the 60 Ton overhead crane. Above this facility a TORIT commercial air-mover unit was installed, to remove the hot-cutting fumes from the ECW Tank Room, filter them to remove particulate matter and then discharge to the secondary containment. The unit's advantage was that it contained a self-cleaning filter so that the unit remained fully operative at all times and did not create lots of waste filters for disposal. Much, but by no means all of the size reduction work was carried out here but Local Extract Ventilation units, (LEV's) were regularly used elsewhere with tented enclosures for some of the size reduction operations. .

Hot Cutting Size Reduction Techniques Used on the SGHWR Plant

In the SGHWR plant there are many steel items for disposal that require size reduction using an efficient and cost-effective methodology. Hot cutting is preferred but here the use of considerable amounts of stainless steel, in some case including sections up to 150mm thick, makes the selection of a cutting process more difficult. It is thus important for NUKEM to identify a range of hot cutting techniques that can be used to section a whole range of steel items including the condenser, de-aerator, emergency cooling water storage vessel, feed heater vessels etc. In these cases three main processes were selected and applied in accordance with the specific characteristics of the materials concerned.

<u>De-aerator</u>

The De-Aerator, located at the top of the plant in a concrete room, was constructed in two sections, comprising an 11m long x 3m diameter lower storage tank with a 4m long x 2.4m diameter upper de-aerator vessel. The unit was surrounded with scaffolding to provide access for hot cutting and its location in essentially a concrete room assisted in minimising the local fire risk. The room was first sealed to allow a ventilated containment to be established for the work and local lifting equipment was examined and recommissioned to assist with waste handling down through a hoist well to lower levels for disposal. The de-aerator was sectioned using mainly oxy-acetylene cutting since the vessel was made from a common grade of steel and was not particularly thick. The round end plates from the vessel were first removed by gas cutting and then the cylindrical sides were cut such that they dropped in sections into the base of the tank. This allowed several pieces to be cut and then cleared when convenient. Work then moved on to the much larger lower vessel where the same process was undertaken. Here the opportunity was taken to cut out a long, curved section of tank wall that was removed to the turbo-alternator area where it was slipped underneath the alternator rotor to enable it to be drawn out and removed out of the building for disposal. The scrap metal acted as a chute upon which the rotor shaft could be moved with its weight supported, allowing the unit to then be safely removed from the building.

<u>Emergency Cooling Water Tank</u>

The cutting of the emergency cooling water tank proved more difficult as it was made of Durasteel varying in thickness from 60-150mm. For this reason the 'Petrogen' cutting system was utilised since a range of different nozzles can be fitted to the cutting head to suit different types and thicknesses of steel. This system uses a gaseous mixture of petrol and oxygen as the cutting medium and its advantage also includes the production of much smaller amounts of cutting debris than standard methods. By this means, the substantial water storage vessel was rapidly size reduced for disposal as required, again working from a scaffolding platform. Its removal also, as noted above, helped provide a central size reduction facility that found wide use throughout the project.

On-Load Refuelling Machine

Finally, some sections from the original on-load refuelling machine were made from very thick steel and required size-reduction for disposal by a hot cutting technique. Here a plasma arc cutting process was selected that can deal with such materials but great care was needed to control the significant amount of fumes produced by this process. During the gas cutting, Petrogen or plasma arc cutting of all these items, the TORIT air mover and filtration unit located on the turbine floor was often used to draw fumes away from the appropriate rooms, sometimes using redundant large diameter pipework as a conduit for the fumes to maintain a safe atmosphere for the operatives and prevent the fire sensors from alarming.

Examples of Diamond Wire Sawing for Size Reduction of Large Items

As noted above, there were many large metallic items to remove and size reduce in the secondary containment of the SGHWR. Although recognised as a slower technique, diamond wire sawing was selected as a size reduction process owing to its adaptability for cutting awkward shaped items. It also acts as a primary cutting process to produce smaller, lighter sections for further reduction by alternative cutting methods. The advantage with the process is that it can be carried out cold and only requires a small amount of water to lubricate the cutting face. The slow cutting speed and use of lubricant also minimises the risk of the spread of airborne contamination during the cutting process. The drive and control equipment is quite small and can be operated by a single person. The diamond cutting medium is impregnated into cylindrical brass or steel inserts attached to a steel wire that can be pulled around an object by a motorised drive with a capability to take up the slack rope as the cutting front advances. In theory this unit can be set up and allowed to progress with minimal supervision but in reality this option is rarely adopted except in the case of simple shaped objects.

Steam Turbine Rotors

One type of large item size reduced using diamond wire sawing is the low pressure section of the two contaminated steam turbine rotors, one being the operational spare. Here the design of the item made disassembly quite difficult and the fan-shaped struts holding the hardened steel inserts were themselves made of alloy steel which is also quite difficult to cut. By positioning the guide wheels selectively, these large circular rings were cut into a square section to allow them as a unit to be placed into a half-height ISO container for disposal as LLW, (Figure 1). This image also demonstrates the means by which much of the LLW from this contract will be disposed of using ISO containers.

Figure 1: Diamond wire-sawing LP rotors for loading into ISO container for disposal

Nuclear Transport Flasks & Feed Heater Vessels

Several other large items were also diamond wire sawn for size reduction purposes including the upper section of the two 1120 nuclear fuel transport flasks and the upper nose cone section of several of the larger steam vessels recovered from the feed heater cell. Figure 2 shows an example of the cutting in progress on one of the feed heater cell vessels where the rounded nose cone is cut away by a single operative working from a remote console. Once these items had been partially size reduced, they were then cut into smaller sections for disposal by other hot cutting methods.

The two 1120 nuclear transport flasks had their inner shielding and fuel baskets removed for disposal at an earlier stage and were thus internally contaminated steel vessels. Diamond wire sawing was used to remove the top ends of both units ahead of disposal, an operation taking several days to complete each time. However, the machine could readily be set up and mostly operated automatically and in this case the slow cutting suited the requirement to minimise any risk of airborne release of contamination.

DECOMMISSIONING OF SPECIFIC PLANT ITEMS

In the sections above some examples of the hot and cold cutting techniques used on SGHWR plant items have been described together with their advantages and disadvantages. In the next section a few examples of the dismantling and disposal of specific challenging plant items are given to illustrate the range of operations and challenges involved.

Decommissioning the Steam Turbine & Alternator

The steam turbine is located inside an enclosure at Level 7 in the secondary containment and comprises a large heavy front section where the steam entered the various stages of the turbine connected to the rear section where the electrical generating alternator was located along with the exciter. The need to dismantle large plant items each weighing more than 10Te has been the theme of this work. The removal of the alternator rotor and exciter train was completed largely by dismantling but the rest of the task has mainly been achieved by hot cutting as already described above. On the steam turbine side the top plates were first cut away to allow access to the high, medium and low pressure sections of the turbine, Figure 2.

Figure 2: Dismantling the steam turbine and alternator sections of the generator

Once removed, access to the lower sections of the steam system was provided and these were steadily cut away for disposal in coordination with the work on the condenser, mounted immediately below. The last two low pressure inner diaphragm sections each weighs 42 Te and are shortly to be lifted away once everything has been completed on the condenser unit located immediately below.

Dismantling the Condenser

The condenser is a large rectangular vessel about 6m x 9m in section and 8m long weighing about 150Te. It contained over 12,000 tubes through which cooling water was pumped via a tube plate to cool the steam discharged into it from the turbine above through an opening in the top plate. The removal of these tubes and the casing of the main vessel was challenging and occupied a period of about 3 months. There were around 80 miles of tubing in all weighing around 120 Te and cutting these away and removing them proved more difficult than had been anticipated. The plan was to first cut off the two sets of end doors using diamond wire sawing but the length of the cuts required were too great and there was not enough power available to achieve this with the standard equipment. Gas cutting was substituted, bringing its own difficulties with smoke emission and access issues. To accommodate this, a large amount of external pipework was removed, particularly the large diameter (1.6m) cooling water pipes from the east end of this plant, the discharge pipes at the opposite end and the steam dump lines. A number of hydraulic oil lines were also drained and removed, which had supplied lubrication to the steam control valves for this plant.

Another task was to create a space below the plant into which the cut sections of the end doors could be lowered to assist with removal from the area. A slot about 0.7 x 1.0m was then cut in the roof of the condenser room to allow access from the main overhead crane to raise and lower items. A hole was also cut in the wall of the cooling water pit to allow the waste tubing to be removed down a chute onto the lower floor.

The possibility of pulling out the brass and cupro-nickel cooling tubes through the end plate was explored but although the process was effective it was too slow (at about 40 tubes/day) and consequently abandoned. Instead, starting at the base area the tubes were burnt through with an oxy-acetylene torch, essentially melting the tubes into 1-1.5m lengths as available between the internal support plates. Control and removal of the cutting fumes within and around the vessel required careful attention and as the work progressed inwards, regular checks had to be made to ensure that the oxygen levels remained sufficiently high to ensure operatives were not exposed to any hazard from this source. Later in the project unexpectedly high local dose rates were experienced within the condenser vessel and staff rotation was required to enable the cutting programme to be completed and still comply with the low project dose restraint objective. All the tubing was further sectioned with a 'chop saw' and placed inside 200 litre drums for supercompaction and disposal as LLW. Although the insides of the condenser tubes were clean, there was evidence of external contamination throughout the vessel, preventing the recycling of this valuable material. The final process was to section and remove the condenser casing using the overhead crane to lift the heavy sections to the waste reduction and packing position in the centre of the turbine hall.

Removal of the Refuelling Machine and Rotating Shields

A general view across the turbine hall of the plant is shown in Figure 3. Here can be seen the original refuelling machine mounted upon the top plate of the rotating shields together with the circular platform upon which the various control cabinets and other electric and hydraulic plant items were installed. It should be noted that this on-load refuelling machine was never taken into operation for reasons not explained here and that a smaller site-constructed off-load machine was provided instead. This machine was carefully

Figure 3: Early stage view across Turbine Hall to Refuelling Machine

dismantled together with the various control cabinets against the possibility of reuse later. In the event this did not occur and the units have all been disposed of as waste.

The larger refuelling machine consisted of a tall steel pressure vessel about 1.9m in diameter and 8.2m high mounted upon a small circular rotating plate mounted within the rotating shields. The rotating shields comprised a large circular plate containing the smaller diameter inner plate mounted above the reactor core such that all the pressure tubes of the reactor could be accessed by the refuelling machine by appropriate rotations. Inside the refuelling machine there was a carousel containing four circular cavities so that two fuel elements could be recovered from the core during refuelling operations and replaced by two more, all at power. The pressure vessel was designed to work at full reactor pressure and temperature and thus was heavily lagged inside with asbestos and contained many pipes, valves and other control gear. At the top end there was a winching mechanism to raise and lower a grab for fuel elements and other in-core components. Additionally the body was well shielded by modular cast iron and steel segments around the central tube.

Dismantling this major item was a challenging task and took many weeks to accomplish. Scaffolding had to be erected around the main vessel to access it safely and a variety of techniques were used to dismantle and size-reduce the materials so that they could be lifted away with the overhead crane. Initially hot cutting was used to section the outer pressure vessel exposing the inner top dome that was diamond wire sawn over 6 days into two 6Te sections ready for lifting away. The main winch mechanism was then removed and a set of nine semi-circular cast iron shielding blocks weighing 1-4.5Te were drilled and tapped to insert lifting eyebolts for their removal. A specialist contractor then removed a quantity of white asbestos from the main pressure vessel, involving the usual precautions such as use of a ventilated enclosure and use of respiratory protection equipment. This allowed the lower sections of the pressure vessel to be unbolted and removed along with a further eight cast iron shielding blocks weighing 7.5-14Te, each drilled and tapped as before for lifting. A further period of several weeks was used to allow removal of a second larger batch of white asbestos, allowing the final lower section of the main pressure vessel to be diamond wire sawn about 4m below the top end. The weight was latterly supported from the building crane as the cutting operations came to an end allowing the item to be lifted away. The 12Te nose cone of the machine had then to be removed before the last section of the pressure vessel could be dismantled. This required an entry into the primary containment where a steel sledge was designed and constructed ready to support the unit and allow it to be pulled backwards about 4m to a lifting position for removal from the area. Various sections of the nose cone were unbolted and lowered using a chain block onto the sledge, which was then pulled back to the lifting position from which the pieces were recovered to the secondary containment for disposal. This allowed the final pressure vessel section to be removed from the top plate of the rotating shields but only after a third campaign of removal of white asbestos (about 16Te in all with the first two batches) had been completed at the lower end after removal of the nose cone.

A large quantity of cast iron blocks and pressure vessel sections were produced during this campaign, amounting to about 170Te in all. Many of these curved blocks had to be size reduced by diamond wire sawing since hot cutting could not be carried out on the cast iron. The sections were all contaminated with tritium and thus had to be disposed of as LLW into an ISO container. The size reduction work took a considerable period of time to complete and the materials occupied a significant area of the storage space. It should be recognised that the operations required on this one major plant item are typical of the range of tasks required throughout this project and illustrate some of the technical challenges faced by the Task Managers every day.

Removal of the rotating shields then followed, the item occupying a large circular penetration into the top of the primary containment. This deep honeycomb structure contained around the perimeter the hydraulic drive mechanisms associated with its various rotations and operation of oil seals to maintain pressure. The internal honeycomb sections all contained local shielding comprising steel shot together with cubes of polythene used to suppress neutrons, the whole unit weighing around 400 Te. These materials were vacuumed out from most of the compartments for disposal as LLW but some sections had to be scooped out manually where they had congealed due to rusting or were contaminated by hydraulic oil such that they could not be recovered with the wet-vacuum system. Finally, the inner and outer circular sections were lifted out in four large sections weighing up to 55 Te with the main overhead crane, Figure 4, for final size reduction and disposal as LLW. A huge amount of steel was involved and the Petrogen

Figure 4: Lifting out the inner section of the Rotating Shields

hot cutting technique was used here to size reduce this item since it works very well on thick steel sections. The process uses a gas mixture of petrol and oxygen for the cutting process and produces much less molten debris than oxy-acetylene methods. A concrete beam structure has since been placed over the remaining roof penetration in the primary containment to close the opening permanently.

Feed Heater Cell

The removal of the plant and equipment from the feed heater cell was the main work in this area and was the project's original critical path task. This cell held a series of vertical steam vessels used to pre-heat the feed water using reject steam from various parts of the steam turbine pressure train. The vessels were relatively large and weighed from a few tons upwards. An ongoing activity during the de-planting of the feed heater cell was the removal of asbestos insulation from this area. Although a clean up and sealing operation had been undertaken during the 1980's this was not to carried out to modern standards and asbestos residue was still prominent. The de-planting and asbestos works needed to be undertaken in isolation and careful management was required to allow this to be achieved without hazard to the operatives. The majority of the size reduction works were undertaken using standard demolition techniques. The most difficult tasks included heavy lifting operations for the removal of the feed heaters from a very compact and congested area. Considerable ingenuity was required to get lifting equipment into the cell but as the area was cleared the task became easier. The large vessels were withdrawn through a pre-existing opening in the cell roof and after some size-reduction were transferred to a hot cutting cell for further treatment ahead of disposal as LLW. These plant removal works have now been completed and the decontamination of the concrete surfaces of the cell to exempt levels is in progress.

Plant Room Clearance

In all a total of about 200 individual plant rooms have been cleared and decontaminated. The work has been varied and included heavy water treatment plant, pond clean-up plant, ventilation systems, the reactor suppression system and service ducts and corridors. Much of the plant decommissioned and dismantled was contaminated and has been size reduced for disposal as LLW, often using 200 litre drums. The final operations have concerned the monitoring of all surfaces in the rooms and their local decontamination where required. These operations have continued throughout the timescale of the project and work has been completed on time without incident.

WASTE HANDLING

Because the SGHWR was a direct cycle reactor, the feed train and boiler feed systems were all contaminated and this has resulted in the need to remove many hundreds of tons of active plant. The activity issues are complicated further by the presence of tritium throughout the facility; this has evolved from the reactor’s heavy water circuit and appears to have been absorbed by the majority of the plant. Some plant items affected were not predicted to contain tritium contamination and it is not immediately clear how the materials became affected. The tritium problem has resulted in a significant increase in the predicted volume of active waste and hence increasing the workload and payload of this key aspect of the work.

Throughout these operations extensive beta/gamma monitoring of waste materials has been undertaken at every work front and some items were shown to be capable of disposal as exempt materials. A small amount of steelwork has been dispatched to UKAEA’s own shot blasting facility located on-site where low levels of contamination can be removed allowing exempt disposal to be a consideration. To date the quantity of material disposed of by this route has remained low and sampling of many materials has confirmed the presence of tritium at levels well above target, <4Bq/g, to allow exempt disposal. The waste team has to date processed over 2000 Te of waste in the 18 month contract period. This volume has never been achieved before in such a short timescale and is matched with record breaking ISO packaging efficiencies.

SAFETY RECORD

The safety record of the project has been good with excellent reporting levels and the introduction of a number of safety initiatives. A number of safety initiatives have been introduced following discussions with the client, including the introduction of point of work risk assessments, workplace intrusive safety audits and observation of behavioural safety.

The intrusive workplace safety audits require the completion of an operating area safety inspection sheet. The inspections were introduced to take the safety walk-round activities closer to the workers and provide the necessary feedback needed to ensure that the safety management systems are being deployed as intended in the workplace. This also allows the work force to gain a better understanding of NUKEM's requirements on safety matters. The point of work risk assessment utilises the STAR principle, (Stop Think Act Review) and has been introduced across the company, allowing final reviews to be undertaken by the operatives at the workface before commencing work. This ensures that any changes resulting in new hazards can be addressed and a pre-work safety checklist completed. By these means, together with the development of a non-confrontational co-working relationship with the client, this very challenging project has been carried out safely and essentially to programme. This working relationship between client and contractor is commended to others carrying out similar important decommissioning projects.

CONCLUSIONS

Decommissioning operations on the SGHWR Stage 1 contract at UKAEA Winfrith, funded by the Nuclear Decommissioning Authority (NDA), are well advanced and nearing completion. A wide range of decommissioning techniques have been utilised throughout this project and several examples involving both hot and cold cutting have been mentioned in the context of dismantling large and heavy plant items. The development of multiple work fronts has contributed to the success of the project as well as a dedicated waste handling team that has processed over 2000 Te of waste in support of the overall project tasks. The project has benefited throughout by the employment of a non-adversarial team working approach between client and contractor, recently adapted to meet the new challenges of working under the newly established NDA administration. This has greatly assisted in developing safe and cost-effective solutions to a number of problems that have arisen during the programme, demonstrating the worth of adopting this co-operative approach for mutual benefit**.**

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