

DECOMMISSIONING AND REMOVAL OF THE FUEL MANUFACTURING FACILITY AT WINFRITH

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ABSTRACT

The Fuel Manufacturing Facility at Winfrith produced plutonium based reactor fuel for some 35 years. During its life approximately 10te of plutonium was processed. Decommissioning for this plant started in the mid-1990's and was completed early in 1999. The decommissioning demonstrated the successful use of portable, modular containment systems to prevent the spread of contamination during glove-box and equipment size reduction activities. High pressure water jetting was also proven as an efficient technique to decontaminate active pipe-work and equipment which minimised the volume of Intermediate Level Radioactive Waste produced.

The decommissioning was largely undertaken under a fixed price contract let by the United Kingdom Atomic Energy Authority (UKAEA). The contract conditions and management arrangements allowed the UKAEA to retain overall control of the work, whilst giving the contractor flexibility to use the best techniques. This proved to be very successful. No personnel injuries, or lost time accidents occurred during the project.

This represents the first green-field decommissioning of a major plutonium contaminated facility in the United Kingdom.

BACKGROUND

The Winfrith Site of the United Kingdom Atomic Energy Authority (UKAEA) was established in 1957 as a research centre for reactor physics and to develop prototype reactor systems. A number of reactors were built on the site, varying in power from a few watts to the Steam Generating Heavy Water Reactor, which produced 330 MW(Th). Various support facilities were also built, including laboratories, fuel manufacturing and irradiated fuel examination facilities.

These facilities are now shut down and the task of the UKAEA is to manage and undertake their decommissioning in a manner that is safe, cost effective and environmentally responsible

The Fuel Manufacturing Facility was built and commissioned in the early 1960's. Its original purpose was to produce plutonium based nuclear fuel for research reactors both at Winfrith and elsewhere. The facility was capable of producing up to 10 te of MOX fuel per year. Throughout its life approximately 10 te of Plutonium was processed through the facility. Towards the end of its operational life, methods for handling and packaging plutonium contaminated wastes (pcm) were developed. An external view is shown in Figure 1.

The basic components of the plant were glove boxes inter-connected to allow the specific processes to be implemented, mostly of steel and perspex construction. These varied in size and contained a variety of equipment used for fuel fabrication. These included ball mills, mixers,

grinders and furnace suites. A glove-box and facility ventilation and filtration extract systems, active drainage system and office and workshop accommodation were also provided. A view inside the building during operation is shown in Figure 2. By the mid 1990's the decision was taken to completely remove and decommission the facility.

This represents the first stage 3 decommissioning of a major plutonium contaminated facility in the UK.

DECOMMISSIONING STAGES

Decommissioning was undertaken in 3 stages, as follows:

- Stage 1, the size reduction and removal of the glove-boxes and their contents.
- Stage 2, removal of the building equipment, ventilation plant, drains etc and decontamination of the structure.
- Stage 3, dismantling and removal of the building structure, basement and restoration of the ground.

These are described in detail below.

DECOMMISSIONING PROCESSES

Stage 1

In many ways Stage 1 decommissioning presented the most difficult challenges to safe decommissioning. Whilst the glove boxes had been emptied of fuel, a considerable and not easily quantifiable quantity of plutonium was known to be held up in the equipment within the glove boxes. Some of this equipment, for example the furnace suites, had not been accessed during the 35 year life of the building. Therefore their detailed internal conditions were unknown. The equipment was also physically large, reaching from floor to ceiling, with a corresponding size of glove box. As well as the obvious contamination hazard, there was also a potential radiation hazard due to the age of the plutonium.

An early decision was taken to use manual techniques with hand held tools to cut up and break down the glove boxes and their contents prior to packaging for disposal. Automated robotic arms had been used successfully for similar tasks elsewhere in the UKAEA, but the variety of dissimilar glove boxes in the facility made automated techniques less practicable.

During this stage of decommissioning the most important consideration was to protect the work force from contamination and to limit its spread during cutting, and size-reduction operations. This was achieved very effectively by the use of portable modular containment systems. These were built from glass reinforced plastic panels to provide a leak tight enclosure. A mobile ventilation/filtration system kept an air flow through the enclosure to prevent the spread of air borne contamination through the main access chamber. Facilities for posting out the size reduced components into waste drums were also provided. Prior to use, the internal surfaces of the

containment structure were coated with a strippable paint. This was re-applied after work finishing, thus sealing in any contamination that had adhered to the first coat. Removal of these coatings proved to be a very effective decontamination process.

Smaller components and glove boxes were lifted into pre-erected containment systems, and operators in pressurised air suits then used hand tools to reduce the equipment into pieces of manageable size. A wide variety of tools were utilised although the most effective were seen to be hand held band saws, nibblers (which produce little or no swarf) and reciprocating saws. For the larger glove boxes, the largest being approximately two stories high, a containment system was built around the box, and sealed to the floor. This proved equally effective in use. In total, approximately 50 glove boxes and their contents, of various sizes were successfully reduced for storage, using this technique. Figure 3 shows a view of the building after the completion of Stage 1 decommissioning.

Stage 2

The most significant of the Stage 2 decommissioning tasks were: the removal of the remaining contaminated systems, notably the glove box ventilation extract ring main and the building active drainage system. The latter also contained a drain sump in which a quantity of plutonium contaminated “sludge” was known to exist; and the decontamination of the internal walls to a level to allow the building to be removed as a non-contaminated structure.

One of the main objectives to this stage was to minimise the volume of plutonium contaminated waste (pcm) generated. This cannot be disposed of to the Low Level Waste (LLW) facility at Drigg, and this needs long term storage and eventual treatment and disposal as Intermediate Level Waste (ILW).

Since the modular containment concept had proved to be very successful during Stage 1, it was used to decontaminate active systems, once these had been dismantled. The glove box extract ring main consisted of some 120 feet of steel pipe, up to 12 inches in diameter. This was removed in sections using a bagging technique to control the spread of contamination. Effective decontamination of each section was undertaken using high pressure water jetting. The modular containment was modified to give a waste-proof base and a water re-cycling system to allow the water jetting to be used inside.

The building active drain system consisted of a primary drain line made of plastic, within a secondary pipe made of steel. The primary lines were withdrawn, using bagging techniques to prevent the spread of contamination, and decontaminated using the technique described above. Secondary steel pipes, embedded in the concrete floor, were successfully cleaned in-situ before removal, using the same high pressure water jetting technique.

Whilst the active systems proved relatively easily to decontaminate, parts of the building structure were more difficult. The internal surfaces had largely been painted. The main operating area of the facility consisted of a steel shell and it was relatively easy to remove the paint using needle guns and prove the structure clean. Other rooms had brick and masonry walls and had had extremely high levels of airborne contamination. The worst room from this aspect was the

pressurised suite area, which had been used for dismantling fuel elements and the maintenance of highly contaminated equipment. The paint was over 10 years old and very hard.

Considerably more effort was required to decontaminate these surfaces than originally anticipated. A variety of techniques were used including scabbing and needle guns. This is physically hard work for operators in air suits and blouses. It was also found to be difficult to stop the spread of contamination onto previously cleaned surfaces unless careful consideration was given to the order of the work in relation to the ventilation air flow direction.

Figure 4 shows a view of size reduction being undertaken inside a modular containment assembly.

Stage 3

Completion of the Stage 2 decommissioning left the structure in a clean state, allowing the final dismantling and removal of the building structure as a conventional demolition process. It should be noted that all building hazards, such as asbestos, had also been removed during Stage 2.

The main point to address for the Stage 3 process, was to ensure structural stability of the main building shell during its dismantling.

CONTRACT MANAGEMENT

During the period of this project the nature and commercial policies of the UKAEA changed. The Stage 1 tasks were undertaken by the UKAEA. Stages 2 and 3 were undertaken on the basis of a competitive contract awarded by the UKAEA. This contract was won by AEA Technology.

The purpose and function of the contract was as follows:

- To ensure that the UKAEA retained control of the project and remained fully responsible for safety.
- To provide value for money for work undertaken.
- To share risks appropriately with the contractor.

On the basis of this the Stage 2 and 3 tasks were let as a single, fixed price contract. A feature of this was to incentivise the contractor to minimise the volumes of radioactive waste produced. The cost of waste disposal fell to the UKAEA and had the potential to be a dominant cost item in the whole project. This incentivisation was successful in ensuring that radioactive waste volumes were minimised.

The control and management of safety by the UKAEA is an important aspect of contract management. To achieve this the contract allowed UKAEA to retain the following responsibilities:

- The approval of the appropriateness of contractor personnel working on the project.
- The approval of all safety documentation, procedures and work instructions produced by the contractor.

- The supervision of the contractor to ensure that approved instructions are followed.

The contractor had overall responsibility for day-to-day management and meeting the project timescale. This arrangement proved very successful in that it allowed the contractor to use his preferred methods and techniques and allowed the UKAEA to retain overall control. A good working relationship between the UKAEA and the contractor was generated, evidenced by the fact that there were very few safety occurrences during the project, and none resulted in personal contamination or injury.

CONCLUSION

This project represents the first green field decommissioning of a major plutonium facility in the United Kingdom. All the building including the sub-ground structures have been removed. Monitoring of the soil has confirmed that any residual contamination is below the level of regulatory concern. In due course, an application will be put forward to the Regulatory Authority to remove the nuclear license from this part of the site.

The project demonstrated a number of issues. On the technical side, these included the use of the modular containment system to prevent the spread of plutonium contamination, and high pressure water jetting for decontamination. On the commercial side, it proved that fixed price contracts can be used whilst allowing proper control and management of safety. The work was undertaken without any significant incident and within dose budget.

Much of the success of the project is due to the good working relationship with the contractor, AEA Technology, whose input into the project is acknowledged.

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Figure 1 External View of Fuel Manufacturing Facility

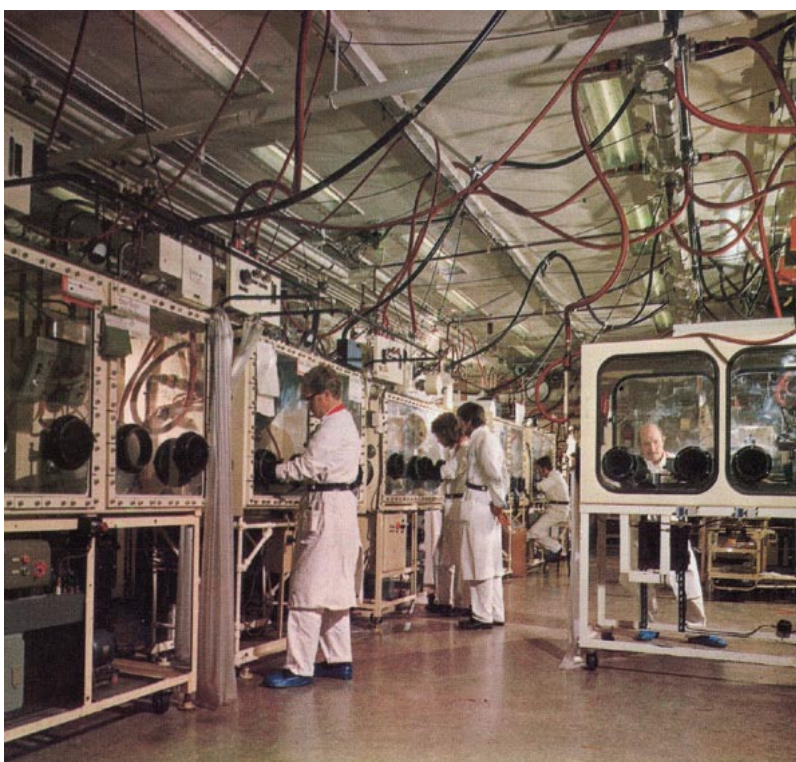


**Figure 2 Internal View of Facility Showing Glove Boxes
in Operation**



Figure 3 Internal View of Facility After the Completion of Stage 1 Decommissioning



Figure 4 View Inside Modular Containment Structure Showing Operator in Pressurised Suit Size Reducing Contaminated Components