MANAGEMENT AND RETRIEVAL OF HISTORICAL NUCLEAR WASTE PREVIOUSLY PREPARED AND CONCRETE FOR SEA DISPOSAL

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ABSTRACT

This paper describes the approach of dealing with an historic legacy of pharmaceutical manufacturing operations, which arose as a result of the temporary cessation of sea disposal in 1983. The result of that cessation was an accumulation of 1,000 reinforced concrete lined steel drums containing intermediate level nuclear waste of mixed chemical and physical form.

Included are the steps taken which established a policy, the resulting strategy and the unique and innovative means by which the plan was implemented. The objective was to reduce the financial liability of the waste contained within the drums by removing those portions that had already decayed, segregating the waste in terms of non disposable and disposable isotopes, size reduction and long-term storage of the residues in a retrievable waste form.

As part of this process the Company established a UK strategy which would ensure that the Company was self sufficient in radioactive waste handling storage facilities until the provision of a national facility, currently predicted to be approximately 2040.

INTRODUCTION

Amersham plc is a manufacturer and distributor of products, which utilise the characteristics of radioactive isotopes. These products have been successfully applied to medical research and therapy. As a by-product of the manufacturing operations involved, radioactive wastes are generated and these consist mainly of items of laboratory equipment, glass, tissues, rubber and residual amounts of spent stock.

Until 1983 all wastes were sealed into reinforced concrete ballasted steel drums which were then transported by road to a Central Government holding facility. This facility was used to store all waste prepared in the same manner by operators within the Nuclear Industry. Once sufficient stocks had been amassed to fill a specially modified merchant ship, the stock was loaded and sent for sea disposal.

In 1983, in response to mounting concerns from Unions and Environmental Groups, the Government proposed the placing of a "temporary ban" on all sea disposal of nuclear waste until a more environmentally-acceptable solution could be found. As a result, Amersham, in line with other companies in related nuclear industries, decided to continue to prepare and seal the drums in the same manner pending the result of the Government inquiry that was expected to recommend the eventual reinstatement of the sea disposal route. Discussions continued until 1995 when it finally became clear that there would be no resumption of sea disposal of any nuclear waste, anywhere in the world. By this time the company had built up considerable stocks of prepared drums which were now classified as intermediate level waste.

During the 1990s a low-level radioactive waste disposal facility was established at Drigg in the North of England and although the waste stored in the sea disposal drums was originally intermediate level waste it was now over 10 years old. The nature of pharmaceutical production is such that many of the isotopes utilised are of short and medium half-life (mostly less than 10 years), and therefore a large proportion of the drum contents had gone through at least one half-life cycle of decay. However, the packing operations originally employed to populate the sea disposal drums were not isotope-specific and now, many years later, the conditions of acceptance for disposal of waste at Drigg are isotope-specific.

The problem faced by the waste team was that although they had access to a new disposal route for low-level waste, the route demanded specific radiological and physical qualities that the waste would have to adhere to prior to disposal. It was clear that the only way of meeting Drigg's disposal conditions was to retrieve and re-characterise the waste, both isotopically and physically.

There were two major problems facing the project team. Firstly, the waste was encased within 3mm of steel which in turn was encased within 6 inches of reinforced concrete, all of which was prepared 13 years previously. Secondly, the age of the waste meant that the extent of physical deterioration and the combination of different physical and chemical types presented an unknown quantity.

Another characteristic of sea disposal was that isotopes were often mixed at random with respect to half-life and no specific measures taken to reduce the volume of waste by efficient packing or segregation of different physical forms.

After a detailed review of the relevant records, it was decided that the most cost-effective approach would be to open the steel reinforced sea drums.

It was clear that such an operation could only be achieved within a purpose-built plant, which would facilitate the opening of drums and retrieval, identification and size reduction of the contents.

Once segregated the waste could be packed into new containers intended variously for long-term storage in the case of intermediate level waste and immediate disposal in the case of low-level waste.

Having established a strategy the writers were faced with the problem of how to achieve implementation. The first part of implementation was to open the drums themselves. At that point no other organisation had attempted opening the drums. It was clear that this operation could only be completed in a controlled, ventilated and extracted environment.

Sea Disposal Drum Retrieval Project

Our presentation will take the audience through the regulatory and logistical processes required to gain access to the waste from the Government store.

It will then track the construction of the plant and the cutting, retrieval, tracking and volume reduction process.

One lunchtime in 1994 the writers were relaxing over a cup of coffee and looking out of the window at the industrial landscape that surrounded them. Part of this landscape was a contractor undergoing the demolition of some tall chimneys that were part of an adjacent industrial installation. The method used was to install a series of peripheral cuts starting at the top of the chimney and working downwards to the base. After the completion of each peripheral cut a cylinder of chimney was removed. Topographically it was clear that each section of chimney was similar to a sea disposal drum, therefore a peripheral cut at the top of the sea disposal drum would remove the lid and expose the contents. The major change in application was the replacement of stationary chimney and moving cut with a moving drum and stationary cut.

From the records of the construction of the drums it was clear that a vent had been installed to allow the ingress of seawater after the original drums had been deposited into the sea. Sectional drawings show that the base of the vent was in the same position as the top of the waste, therefore by the simple expedient of inserting a graduated probe into the vent, the surface of the waste could be identified and then 25 mm below the surface of the waste would be the position of the cut. It was recognised, however, that the cut would have to be of a depth that did not cut into the waste but did cut through the peripheral reinforcement of the drum. Once that cut had been completed there would still be 25-50 mm of concrete remaining between the waste and the inner extent of the cut. To overcome this problem it was recognised that once the reinforcement had been cut the remaining concrete would be un-reinforced and hence be weak in tension. The method of achieving the final removal of the lid was to cut a 50 mm core coincident with the peripheral cut, remove the core and then insert a hydraulic splitter which overcame the concrete tension and hence separated the lid from the main body of the drum.

Once the lid had been removed the next activity was the removal, sorting and size reduction of the waste. The waste is removed using conventional tongs and percussive equipment to free the waste from the surrounding concrete and then remove the waste into the next stage of the retrieval process. Individual cans were monitored remotely to check the nature and amount of activity when compared to the records and this having been confirmed, the waste was streamed either for immediate disposal or further treatment.

Once the waste for immediate disposal had been removed the waste was transferred to a x-ray facility which was used to review the physical contents of the can with respect to the presence of liquids or uncompactible items. If either of these items were present, the can was opened and the offending items removed. The can was then transferred to the super compaction suite where a reverse compaction unit was employed with a 6 tonne thrust which typically achieved reduction factors of between

5 to 1 and 8 to 1. After compaction the cans were shrink wrapped in PVC bags and then placed into an over pack can whose diameter was slightly greater than that of the compactor can (typically the over pack can contained between 5 and 8 compacted pucks). Once the over pack can was full the can was transferred into 500 litre stainless steel NIREX type containers for long-term storage (40 years +) anticipating the construction of a UK facility for the storage and management of intermediate level waste.

As a result of these activities emptying each drum resulted in an empty carcass consisting mainly of the concrete shell and the steel skin. Each carcass was core sampled several times so that a radiological fingerprint could be established. The carcasses were then streamed for immediate disposal, long-term decay or for combination with other radioactive waste to optimise radiological and financial characteristics for shipment.

Part of the process outlined above was the identification of the original waste streams and the tracking of the treatment process through to the final placement within the 500-litre drum and the placement of that drum within a storage facility. A database system was designed and established which successfully traced the treatment and storage process of each item of waste from its arrival at the facility to its final placement. In addition, the strategy of storing the waste in 500 litre drums, and the sorting of waste at the receiving site, required the construction of a new Materials Handling Centre. This building had sufficient capacity to store the waste arising from these activities, commencing with the waste retrieved from the sea disposal drums, then adding the waste that would arise over the next 40 years. This facility was completed in parallel with the treatment plant.

After the temporary cessation of sea disposal in 1983 some 3,000 drums were stored in a facility at Harwell. The drums belonged to 5 different organisations and were stacked at random within the building. In order to establish the drums to be treated as part of the process it was decided to sort the drums most suited to the isotopic mix, those for treatment at the Cardiff facility and those for treatment at the Harwell facility.

In addition, the drums had to be sorted into loads that could meet the specific requirements for disposal at the Low Level Waste facility at Drigg and to meet the requirements of isotopic content, surface dose, disposal costs and the overall shipment programme as agreed with the Environment Agency. Within this exercise were particular problems related to ensuring the loads remained stable during transport and to deal with any problems arising from secondary contamination of the reusable transport containers.

The project was addressed in two phases. The first phase was the retrieval of 300 Carbon 14 and Tritium contaminated drums from the Government Storage facility at Harwell. This waste was transported to the Cardiff Laboratories site where a purpose-built plant was being designed and constructed to include facilities for identifying, cutting, segregating, sorting and compacting waste packages.

The Waste and Decommissioning Group, with the assistance of a Fabrication Contractor, designed and built a specially made unit that addressed all the project requirements whilst providing a safe working environment for the operating staff. Following the pilot programme of 60 concrete drums, a further 240 drums (held at Harwell) were returned to the Cardiff site for treatment in a Mark 2 mobile treatment unit. A total of 300 Concrete containers, with a combined volume of $150m^3$, were processed and the radioactive waste reclaimed with a resultant reduction in volume of 86%.

The rationale behind this project was to reduce the provision set aside for dealing with this historic waste. As a result of the works now completed the provision has been reduced by 75% with the remaining costs sufficient to cover disposal of the final waste form and 500-litre drums. Accordingly, the project was considered a financial success.

The second phase is currently in progress at Harwell, which is the processing of a further 300 mixed isotope sea disposal drums. This plant is capable of handling the full range of alpha emitters as well as higher dose beta gamma wastes. Thus for the first time the plant is heavily shielded, though as before, it is a fully extracted and controlled environment.