WM'03 Conference, February 23-27, 2003, Tucson, AZ

CONDITIONING OF INTERMEDIATE-LEVEL WASTE AT FORSCHUNGSZENTRUM JÜLICH GMBH

H. Krumbach
Forschungszentrum Jülich GmbH (FZJ)
52425 Jülich, Germany

ABSTRACT

This contribution to the group of low-level, intermediate, mixed and hazardous waste describes the conditioning of intermediate-level mixed waste (dose rate above 10 mSv/h at the surface) from Research Centre Jülich (FZJ). Conditioning of the waste by supercompaction is performed at Research Centre Karlsruhe (FZK). The waste described is radioactive waste arising from research at Jülich. This waste includes specimens and objects from irradiation experiments in the research reactors Merlin (FRJ-1) and Dido (FRJ-2) at FZJ. In principle, radioactive waste at Forschungszentrum Jülich GmbH is differentiated by the surface dose rate at the waste package. Up to a surface dose rate of 10 mSv/h, the waste is regarded as low-level. The radioactive waste described here has a surface dose rate above 10 mSv/h. Waste up to 10 mSv/h is conditioned at the Jülich site according to different conditioning methods. The intermediate–level waste can only be conditioned by supercompaction in the processing facility for intermediate-level waste from plant operation at Research Centre Karlsruhe. Research Centre Jülich also uses this waste cell to condition its intermediate-level waste from plant operation.

INTRODUCTION

Since 1962 radioactive waste has been interim-stored at Research Centre Jülich (FZJ) in a store specially constructed for this purpose. With increasing volumes of waste, a differentiation was made between low-level waste (LLW) and intermediate level waste (ILW). The waste is differentiated on the basis of the surface dose rate. All packages with a surface dose rate of more than 10 mSv/h are interim-stored in storage cells especially erected for the storage of intermediate-level waste. These cells consist of concrete internals, which are covered at the top by concrete beams. Two cells are constructed in the form of so-called tunnel conveyors. With these cells, it is only possible to emplace drums via a loading shaft. Through this loading shaft, the drums are placed on an inclined roller conveyor and thus roll automatically into their storage position. These drums are then removed through a withdrawal shaft at the other end of the tunnel conveyor. The cells of the ILW store are exclusively designed for accommodating 200-l drums with rolling hoops and a V-ring lid. After 40 years of interim storage, about 70% of the storage capacity in the ILW store is now occupied.

Since the stored waste is mainly raw waste, the storage volume can be reduced by conditioning the waste, e.g. by supercompaction. It was originally planned to cement this waste by pouring cement into the cavities. However, since supercompaction is also licensed as a suitable and well-qualified procedure, supercompaction was selected as the conditioning measure.

Supercompaction achieves a reduction in the volume of waste, which leads to a reduction of repository fees if the waste is delivered to a final repository. The conditioning of this waste requires the use of a specially shielded waste processing cell.

Research Centre Karlsruhe (FZK) has such a cell facility for conditioning intermediate-level waste which Research Centre Jülich can use for conditioning its waste. Before the waste is transported to Karlsruhe for conditioning, the data recorded upon emplacing the waste must be checked and updated. This is done by a measuring program at the waste drums in which the dose rate and package weight are redetermined. Furthermore, a gamma scan is made of each drum. These data are used to draw up the transport documents. After the waste has been transported from Research Centre Jülich to Research Centre Karlsruhe, it is unloaded at Karlsruhe and sorted in the ILW cell. The sorted waste is filled into compaction drums and then supercompacted. Processing at Karlsruhe is documented. These data are then used again for the return transport from Karlsruhe to Jülich. In Jülich, the conditioned waste is once again emplaced in the ILW store. The entire processing of intermediate-level waste is performed in accordance with a test sequence plan procedure commonly used in Germany for the conditioning of radioactive waste.

PROCESSING THE OLD DATA

The data available for the old waste are mainly restricted to the specification of origin, activity and dose rate at the surface of the package or shielding cask.

The old data have to be supplemented for the transport of the packages from FZJ to FZK.

Measuring Program for Determining the Radiological Data

The existing database (in part 40-year-old data) is not sufficient for the transport of the drums from Jülich to Karlsruhe and for a documentation of radioactive waste according to current standards. Today, in addition to the dose rate and the total activity at the package, nuclide-specific data and information about the type, age and origin of the waste have to be included. To this end, first the dose rate and the package weight of each drum in the ILW store will have to be determined again. A measuring cell (cell 11 of the ILW store) is available in the ILW store to record the radiological data. This measuring cell is equipped with a dose rate measuring stand (Fig. 1), where the drum is placed on a turntable. Stationary ionization chambers at the circumference (at three different heights), at the bottom and at a distance of 1 metre measure the dose rate at the waste package. The measuring stand is positioned on a balance so that the package weight can be determined while the dose rate is being measured. The recorded data are processed electronically on a computer.

If required, a dose rate profile of the waste drum can be created. The time and the date of measurement can also be reconstructed for each measurement. An initial classification of the packages for transport to Karlsruhe is performed on the basis of the dose rates and package weights thus determined.

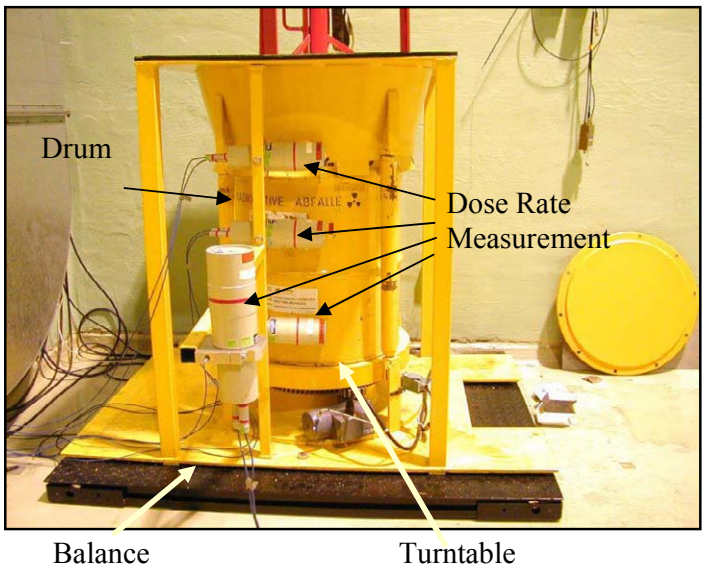

Fig. 1. Dose rate and package weight measuring stand in the ILW store (1).

Gamma Scan at ILW Drums

In order to obtain data on the activity inventory in the drums and to check the activities specified by the waste supplier, a γ scan is performed at each drum. A germanium detector (Fig. 2), operated by the Institute for Safety Research and Reactor Technology (**ISR**), is available for this purpose at Research Centre Jülich. The radionuclides determined by the γ scan are entered into a computer program as measured values.

Fig. 2. Arrangement of the measuring system in measuring cell 11 (1).

CONDITIONING OF ILW DRUMS

A nuclide vector is used to calculate the activities for other radionuclides also required for drum transport.

The computer program is an EDP program especially developed for monitoring the waste flow. The data required for acceptance of the ILW drums at Research Centre Karlsruhe can be generated with this program. The documentation required for package transport can also be produced with this EDP program. Research Centre Karlsruhe can then further process the data electronically. The input activities of the drums transmitted with the transport are administered at Research Centre Karlsruhe by the EDP system used there. The data are updated in accordance with the processing steps. In this way, the data required for the return transport of the packages are obtained at the end of waste processing.

Test Sequence Plan Procedure

Conditioning of intermediate-level waste is performed in accordance with a test sequence plan procedure normally used in Germany for the conditioning of radioactive waste. This test sequence plan describes all the handling steps for preparing the transport, the transport itself, conditioning and return transport. The test sequence plans are submitted to the competent authorities for approval. Since conditioning takes place at various sites, two related test sequence plans are used in the conditioning of ILW. The test sequence of Research Centre Jülich describes the activities for transport preparation such as measuring the dose rate and the package weight. Furthermore, this test sequence plan describes transport of the drums to and from Research Centre Karlsruhe. Authorization for application of the test sequence plan is granted by the regulatory authority responsible for the storage of radioactive waste in Jülich. The test sequence plan of Research Centre Jülich incorporates the test sequence plan of Research Centre Karlsruhe for the conditioning of intermediate level waste. This ensures a transparent conditioning procedure. The test sequence plan of Research Centre Karlsruhe exclusively describes the processing of waste at Karlsruhe. It lays down the acceptance, the processing and the criteria for special treatment of, for example, wet waste.

Transport from FZJ

Packages with a surface dose rate of up to 10 mSv/h are transferred from the ILW store to the LLW store and conditioned at Jülich.
Packages with a surface dose rate between 10 and 30 mSv/h and a package weight of approx. 100 kg can be transported to Research Centre Karlsruhe in concrete containers (normal concrete containers and heavy concrete containers). These containers have a concrete wall thickness of 20 cm. For the normal concrete containers the concrete density is 2.5 kg/dm^3 and for heavy concrete containers 3.5 kg/dm^3. This is sufficient to shield the dose rate of the drums to such an extent that the transport regulations currently in force can be observed. The dose rate at the outer surface of the transport package should be shielded to such an extent that the value for the surface dose does not exceed 2 mSv/h.

Eight 200-l drums (Fig. 3) can be transported in one concrete container. The concrete container is placed in a 20-foot container for transport.
Packages with a dose rate between 30 and 100 mSv/h can only be transported to Research Centre Karlsruhe in thick-walled cast-iron shieldings. MOSAIK® casks are, for example, used for this purpose. For transport purposes, these casks are also placed in the 20-foot container. The waste is transported between Research Centre Jülich and Research Centre Karlsruhe by road. Radiological measurements are performed at the transport vehicle before the drums are removed from Research Centre Jülich. This measuring report is a document for compliance with the applicable limit values for the transportation of radioactive goods. It is used by Research Centre Karlsruhe for reception control on accepting the radioactive waste. To date, 64 200-l drums packed in 8 concrete containers have been transported from Jülich to Karlsruhe.

Fig. 3. Concrete container loaded with 8 drums

Processing of ILW Drums at FZK

The ILW scrapping facility at Research Centre Karlsruhe serves to reduce dismantled plant parts of intermediate- and higher-level activity, e.g. core components from reactors, by remote control and to produce volume-reduced waste products ready for final disposal (2).
In order to perform this task the existing facility was refurbished from 1993 to 1997 at a cost of approx. € 12.5 million (2).

The facility consists of several parts, such as a small and a large working cell, a small and a large loading and unloading cell for conditioning intermediate-level waste. The "large working cell" is used for conditioning intermediate-level waste from Research Centre Jülich. It is planned to transport roughly 300 to 400 drums with intermediate-level waste to Karlsruhe for conditioning.

Large Working Cell at FZK

Intermediate-level waste is processed at Research Centre Karlsruhe in the large working cell. The large working cell at Research Centre Karlsruhe is equipped with:

a power manipulator
a 5 Mg bridge crane
hydraulic shears with 800 kN cutting force
a hydraulic press with 20,000 kN compacting force
a hacksaw for components with a span of up to 400 mm and
two master/slave manipulators at each cell window

The cell is thus optimally equipped for conditioning intermediate-level waste from plant operation such as the waste from Research Centre Jülich.
The radioactive raw waste from Research Centre Jülich has to be repacked in compaction cassettes in the large working cell at Research Centre Karlsruhe before being processed in the supercompaction facility. It can be decided here whether the 200-1drum, now empty, can be reused or discarded. The following activities are performed at FZK in accordance with the points in test sequence plan:

- sorting and reduction in size of the raw waste
- compaction in the supercompaction facility
- pellet control
    - measuring pellet height
    - weighing the pellets
    - leakage of moisture
    - special treatment of damaged pellets
- drying of wet pellets
- weighing the drums
- measuring the dose rate
- measuring the contamination
- calculating the product data

Return Transport from FZK

Return transport of the conditioned waste packages will follow immediately after waste processing. A ratio of 1:3 is assumed as the reduction factor for processing intermediate-level waste. This means that 3 processed 200-l drums form a new waste package. However, since no waste processing has yet taken place at FZK this value cannot be confirmed as yet.
Since the waste is packed together higher dose rates must be expected at the drums for return transport. More transports in shielded cast-iron casks will therefore be required. Packages which cannot be returned to Jülich after conditioning due to the surface dose rates being too high will remain in Karlsruhe for decay storage. At Research Centre Jülich, the returned drums will be removed from their shielding.

A reception measurement is performed at the drums in the measuring cell of the ILW store. Before emplacing the packages in the storage cell the package weight and the dose rate are verified. The conditioned packages are stored separately in the ILW store away from the drums with raw waste. The conditioned packages will be stored in the ILW store until it is possible to transfer them to a repository. At the moment, an interim storage period of approx. 30 to 40 years is expected.

References:

1. Dr. G. CASPARY “Gamma Spectroscopy on 200 l Intermediate Level Waste Drums for a Fast Activity Estimation” PowerPoint Presentation, Forschungszentrum Jülich GmbH ISR Germany (2000)

2. Homepage Forschungszentrum Karlsruhe, Abteilung HDB Germany (as of November 2002)