# TREATMENT OF ROD SHAPED INTERMEDIATE ACTIVE WASTE



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**Abstract.** The Central Decontamination Operation Department (HDB) of the Research Center Karlsruhe operates facilities for the disposal of radioactive waste. In general, their objective is to reduce the volume of the radioactive waste and to obtain waste products suitable for repository storage.

One of the central facilities of the HDB is the intermediate level waste (ILW) scrapping facility which processes intermediate level waste. Since the ILW scrapping facility was not large enough to handle radioactive waste coming from the dismantling and operating of nuclear facilities, HDB expanded and built a larger hot cell. It contains a hydraulically driven metal cutter with a guiding channel and a high pressure compactor. A major task in the hot cell of the ILW scrapping facility is disposing of fuel boxes. These are cut in pieces and scrapped, which is a unique technique in Germany for fuel box disposal.

HDB's experiences in disposing of radioactive waste in the ILW scrapping facility will described in detail, with special emphasis on the handling of rod shaped components.

## INTRODUCTION

The Central Decontamination Operation Department (HDB) is a subdivision of the Forschungszentrum Karlsruhe GmbH responsible for the treatment of radioactive waste. Therefore, the HDB operates among others a facility for conditioning intermediate level waste (ILW). Since the HDB processes waste from the dismantling of research reactors and the reprocessing facility at the Forschungszentrum Karlsruhe, as well as from external nuclear power plants, the amount and the dimensions of the accumulating waste required the installation of a new ILW scrapping facility. The main prerequisite was to reach a significant reduction of the resulting waste product volume in order to lower the final storage costs. Several new concepts of handling ILW were incorporated into the new facility. Since its commissioning in 1997, the conditioning of fuel element boxes and rod shaped components from the dismantling of a research reactor has proved the applicability of these tools.

## OVERVIEW OF THE ILW SCRAPPING PLANT

Figure 1 shows an overview of the new ILW scrapping plant. The design reflects the successive steps of the conditioning process:

The process starts with the unloading of the transport casks. The locks and the transport equipment of the ILW scrapping plant are designed to handle the following types of transport casks with inner containers:

- Large transport containers with a total mass of up to 100,000 kg
  To unload the transport containers, they are placed on a railcar and moved into the transport cask lock. Then the cask is moved to the docking system of the shielding gate between cell 130 and the transport cask lock. The shielding window can be opened only after the cask is tightly coupled to the lock. Then the remote-controlled removal of the lid and the unloading of the carrier cage from the transport cask into cell 130 takes place.

- Transport containers of up to 1500 mm height and single drum containers (e.g. German standard

type container MOSAIK II)

They are transferred into the loading/unloading cell by use of a transport carriage. There, the lid of the transport cask is removed by a remote–controlled heavy load manipulator, which is also utilized to move the waste-filled inner containers onto another transport carriage. The delivered waste is required to be packed in inner containers to prevent an inadmissibly high contamination of the loading/unloading cell. The inner containers are subsequently locked into the storage and loading cell.

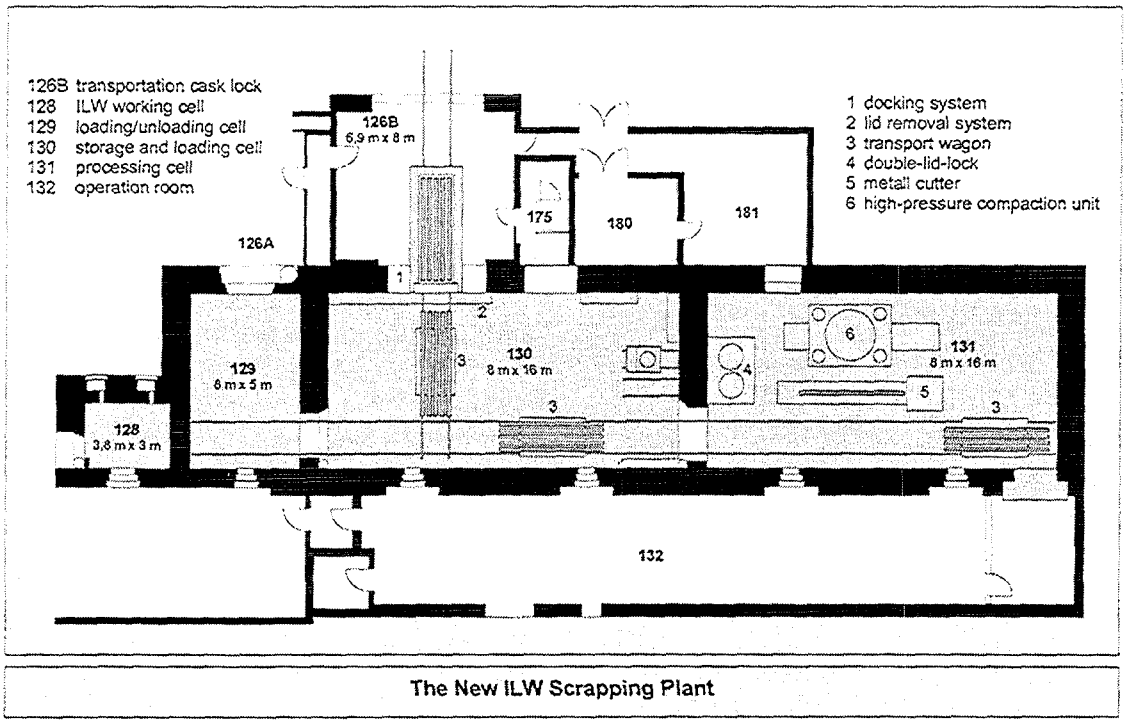


*Fig. 1: Schema of the ILW scrapping facility*

Cell 130 is used for maintenance and repair work as well as for the decontamination of containers and machinery, if necessary. From here, the inner containers are moved on to the processing cell via two different lock mechanisms depending on their geometry. Drums with a volume of 200 l and 400 l, respectively, are handled by a special drum lock. All other containers are transferred into the processing cell through a shielding gate by transport carriage.

In the processing cell, metallic waste of a size corresponding to the inner dimensions of 200 l and 400 l drums as well as bulky waste such as tubes, profiles or steel tanks up to a length of about 4.5 m can be processed and conditioned.

According to the processing concept, the contaminated or activated waste is, if necessary, sorted on a sorting table using master-slave manipulators. To reduce long components such as core internals to small pieces, the processing cell contains a hydraulically driven metal cutter with a guiding channel and a cut length limitation unit (Fig. 2). The resulting pieces are packed into cylindrical sheet metal cartridges, which fit into the high pressure compaction unit. There, a volume reduction by a factor of 4 to 6 is achieved by a compaction pressure of 500 bar. The compaction unit can be equipped with three different stamps whose diameters are 535 mm, 624 mm or 710 mm, respectively. The stamp exchange is done remote-controlled by manipulators. The advantage of this is the ability to adapt to different waste dimensions.

Afterwards, the processed and compacted cartridges are packed into drums. These are returned to the loading/unloading cell via the drum lock and cell 130. In this cell, the packaging into containers suitable for final storage is performed. Following the release measurements, these containers are

removed from the ILW scrapping plant.

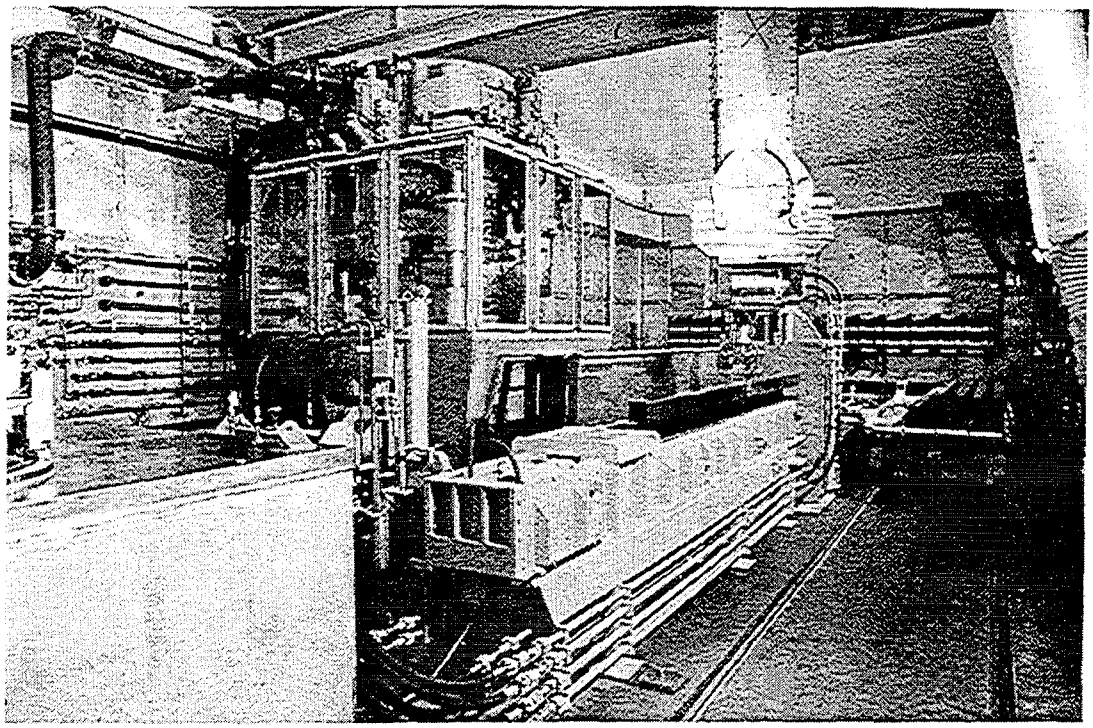

*Fig. 2: View of the processing cell with metal cutter and high-pressure compaction unit*

## CONDITIONING OF ROD SHAPED COMPONENTS AS AN EXAMPLE OF ILW WASTE

In the course of dismantling of the Multi Purpose Research Reactor on the premises of the Karlsruhe Research Center in total 280 rod shaped components have been arisen. These rod shaped components have been located in the high pressure vessel inside the reactor. The components are:

- 121 fuel element linkages
- 117 separation pipes
- 18 control and absorption pipes
- 3 systems to feed in boric acid
- 2 thermo-elements
- 1 multi ventilation system

During the dismantling the components have been pulled out of the pressure vessel applying remote control. The remote control handling was necessary, since the dose rate of the components was between 80 mSv/h and 5 Sv/h. By pulling out the components they are inserted instantly in a special reusable shielding containment. To transfer the rod shaped component into a one-way transportation shielding box the reusable shielding containment is turned over. In the special toppling system the rod shaped component is taken out of the reusable shielding containment and put inside the transportation shielding box. The shielding box is inserted in a special transport container and brought to the Central Decontamination Department for the further treatment. Altogether 277 transports have taken place.

The treatment of the components takes place at the ILW scrapping facilities. The transport container is unloaded and the components are locked into the processing cell. In this cell all components besides the fuel element linkages are cut into small pieces by the hydraulically driven metal cutter. The cutting is done without unpacking the components from the transportation shielding box. Therefore the shielding box is cut including the components. The metal pieces are filled inside special 170 l drums

for super compaction.

The transport boxes with the fuel element linkages are opened and the fuel element linkages are taken out. The lower parts of the linkages and transport boxes are also cut with the hydraulically driven metal cutter and filled in 170 l drums. The upper parts of the linkages cannot be cut using the hydraulically driven metal cutter, since they are too massive. Therefore the upper parts are cut mechanically and filled in 200 l drums.

The 170 l drums are super compacted to reduce the volume to a minimum. The resulting pellets are also put into 200 l drums. The 200 l drums are inserted in a special single cast shielding container, which is suitable for a later final disposal. The 200 l drums with the cut upper parts of the fuel element linkages are put inside special cubic heavy concrete container, which can hold 8 200 l drums.

By super-compacting the rod shaped core internals the total volume of the ILW waste could be reduced by a factor of approximately 4. It was also possible to produce waste products in accordance with the German acceptance criteria for a later final disposal.

## CONCLUSION

The processing of ILW waste in the ILW scrapping plant has shown that the described method of handling rod shaped components applying remote control is a very good possibility of conditioning. Besides, experience has shown that the cutting of metal waste followed by super compaction is very practicable and economic due to the savings in final storage volume. Furthermore, compared to other methods of conditioning, the dose rate for the personnel is also reduced to a minimum.

After a few adaptations in the new ILW scrapping facility nearly all kind of core internals can be conditioned. Therefore, the new ILW scrapping plant provides flexibility and effectiveness in handling ILW.