

Packages for Final Storage with Optimized Use of Metallic Waste - ABSTRACT

1 Economics

The decommissioning of nuclear plants will in the future increase the amount of metallic waste that has to be disposed of. These wastes can be used only for products that remain in the nuclear cycle like packages. Recycling substantially reduces the volume of waste and has great economic benefits over direct final storage. At present the amount of recycling is rather limited because the wastes contain embrittling elements that impede the production of ductile cast iron.

2 Design concept

The packages investigated in the ongoing research project FORM are to be used for final storage. They must be designed for the challenging condition of a 5 m drop without impact limiters at -20°C in the most unfavorable orientation. Geometric design optimizations reduce the stresses in the package under this loading. The ongoing design work is to correctly predict the stress fields followed by a fracture mechanics safety evaluation.

3 Metallurgical concept

There are many embrittling elements in the metallic waste to be used in package manufacturing. Investigations are aimed at finding the quantitative influence of each element on the material properties. The goal is a statistically based prediction of material properties in the casting for any element combination. The brittle as-cast state can be transformed into a primarily ductile state by ferritizing heat treatment. Besides the heat treatment a suitable as-cast condition of the packages is a prerequisite for the heat treatment to be successful. This can be achieved by metallurgical and other measures.

4 Drop testing

The need for higher ductility and fracture toughness was underscored by the rupture, in a 5 m drop test, of a cubic container Type VII. One of several notches in this container had been enlarged too much after a preceding successful 5 m drop test with smaller notches. A cubic container type VII and a cylindrical package with improved properties will be manufactured and drop tested. Afterwards, both packages will be investigated for crack initiation and in-situ material properties.