



## Conditioning Methods

GNS treats all types of low and intermediate level waste (LLW/ILW) and applies suitable conditioning processes to ensure acceptability of the waste for interim storage and subsequent final disposal. Stationary and mobile, predominately in-house developed equipment is used to treat the waste. Furthermore, these are also offered for sale. With the aid of the customised solutions, all operators of nuclear facilities are also able to benefit from the know-how gained over four decades of successful waste treatment.

	<u>Dry Solid Waste</u>	<u>Wet, Sol- id Waste</u>	<u>Liquid Waste and Sludge</u>	<u>Ion Ex- change Resins</u>	<u>Core Compon- ents</u>
<b>FAKIR</b> Hydraulic Supercompactor	■	■			
<b>PETRA</b> Drying Facility		■	■		
<b>FAVORIT</b> Vacuum Drying Facility			■	■	■
<b>PUSA</b> Powder-Resin Transfer Facility				■	
<b>FAFNIR</b> Waste Conditioning Plant				■	
<b>NEWA</b> De-Watering Facility				■	
<b>ZVA</b> Cutting and Packaging Facility					■
<b>UWS</b> Underwater Scrap Shear					■
<b>KETRA</b> Drying Facility					■

### Dry Solid Waste ↑

Protective clothing, cleaning cloths, metal parts, insulation materials, cables and filters are examples of dry solid radioactive waste occurring during the operation and shutting down of nuclear facilities. To this end, GNS has developed the mobile hydraulic supercompactor FAKIR, which significantly reduces the volume of this waste. Depending on the kind of waste, a reduction in the volumes by a factor of up to 10 is possible. GNS itself is operating a hydraulic supercompactor FAKIR at its location in Jülich. GNS can also tailor the device to specific conditions on site; it can be designed, built and commissioned to meet the customer's individual requirements. An even greater reduction in volume is achieved by incinerating combustible parts of the waste. GNS is offering this disposal solution to its customers as an

integrated service ranging from preliminary planning to storage of the products. GNS closely cooperates with various operators of incineration plants. The highest priority is to meet the strict emission protection requirements during combustion. After incineration, most of the radioactivity in the untreated waste is contained in the ashes which are then processed by GNS to create products acceptable for final disposal. These products can no longer ferment or putrefy and are therefore suitable for long-time storage.

## **Wet, Solid Waste** ↑

Some of the waste accruing during the operation and decommissioning of nuclear facilities is wet. In order to obtain a waste product suitable for interim storage and final disposal, this waste needs to be dried. To this end, GNS has designed the mobile drying facility PETRA® for use in nuclear facilities. PETRA® works according to the principle of vacuum drying. Additional energy, supplied by heating the stainless steel drums containing the waste in heating chambers, accelerates the drying process.

Using the mobile drying facility, sixteen drums with a volume of 200 litres, twelve 280 L drums or eight 400 L drums can be dried simultaneously in two heating chambers. A programmable logic controller (PLC) allows automatic operation without supervision. Systems for use in the widest array of nuclear facilities can be adapted to varying framework conditions. The highest possible degree of flexibility and profitability is achieved through modularity.

## **Liquid Waste and Sludge** ↑

GNS uses the mobile vacuum drying facility FAVORIT® for volume reduction and solidification of activated liquid waste (such as evaporator concentrates and sludge) arising during the operation and decommissioning of nuclear facilities. The extent of volume reduction depends on the solid matter content of the liquid waste. The resulting products are suitable for transport and interim storage and meet the requirements for final disposal of radioactive waste. The facility designed by GNS dries liquid waste in drying containers using the principle of vacuum drying. Following a decrease of the internal pressure in the container, free liquid is drained off the waste to be dried. Simultaneous heating of the waste containers by means of jacket heaters or, alternatively, by means of circulating-air heating cabinets for drums accelerates the drying and prevents icing of the interior of the cask. Depending on the specific activity of the liquid wastes, either MOSAIK® II casks or 400-/200-litre drums are used. The volume made vacant can be refilled with waste which in turn can be dried. This process is repeated until an adequate filling level is achieved. Virtually any required throughput can be obtained by combining several modules.

## **Ion Exchange Resins** ↑

Powder resins are being used for treatment of the water in nuclear power plants with boiling water reactors. They need to be replaced at regular intervals and disposed of as radioactive waste. To meet the requirements for interim storage and final disposal, GNS is operating the mobile powderresin transfer facility PUSA for conditioning of dry powder resins and other dry filter aids. The facility was developed and built by GNS and the modular design of the facility enables adjustment to specific conditions on site. The PUSA facility is used in individual campaigns at the power plants. Using a vacuum lifting method (negative pressure), dry, free-flowing powder resins are transferred from 200-litre drums into GNS Yellow Box®. A

programmable logic controller (PLC) allows automatic operation of the facility. The waste conditioning plant FAFNIR® can transfer bead resins used to treat water in the nuclear power plant into MOSAIK® II casks suitable for final disposal both from the power plant's own storage tanks and from pre-filled nodular resin containers. Due to the individual installation options provided by FAFNIR®, specific conditions on site can be accommodated. Conditions for interim storage or final disposal require that the resin-filled waste containers contain less than 1% free water. To fulfil this criterion, GNS has developed the mobile dewatering facility NEWA®. These facilities likewise consist of modules which can be adjusted to local requirements.

## Core Components

During the operation and shut down of nuclear facilities, reactor internals and core components need to be disposed of. For this purpose, GNS has developed various devices for cutting and packaging core components for underwater use in the wet storage pool, e.g. the cutting and packaging facility ZVA.

The ZVA facility is a flexible conditioning device which cuts these components and then compacts them inside a cask to reduce the volume. To be suitable for interim storage and final disposal, the cask contents must not exceed a defined residual moisture value (e.g. to prevent formation of radiolysis gases). Therefore, the casks need to be dried after they have been filled. For this purpose, GNS has designed and built the mobile drying facility KETRA®. Just like other GNS drying facilities it operates according to the vacuum drying principle and can be adapted to the local conditions owing to its modular structure.