SAFELY LOCKED UP

ZWILAG

KEY FIGURES

COMPANY

Founded	1990
Construction period	1996–2004
Construction costs	538 Mio. CHF
Staff	60

STORAGE BUILDINGS

Storage capacity for casks	200 casks
Storage capacity for intermediate-level waste approx.	24 000 drums (384 ISO 20'-container)
Storage capacity for low- and intermediate-level waste approx.	78 000 drums (1144 ISO 20'-container)

TREATEMENT OF WASTE IN THE PLASMA PLANT

(all values indicated are mean values)

Operating time per year	165 days
Duration of plasma torch operation	1750 hours
Furnace temperature during operation	1400 °C
Processed quantity of waste drums per year	900 drums
Processed quantity of waste per year	180 tons

Legal notice
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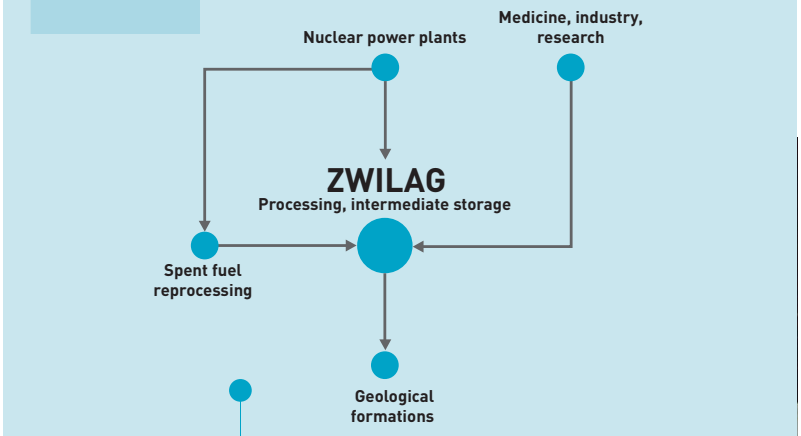
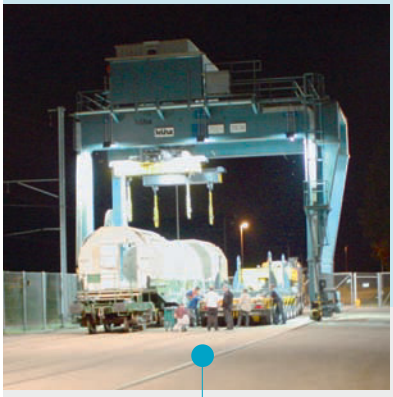


ROUTE TAKEN BY RADIOACTIVE WASTE

Waste arises everywhere: from industry, agriculture, trade, service enterprises and domestic households. A modern society carries the responsibility for the waste it generates. In Switzerland, it is acknowledged that the problem of waste has to be viewed holistically: wherever possible, waste must be prevented from arising in the first place. If such waste is unavoidable, ideally it should be fed back into the production cycle. Unusable waste should be tackled in a manner that is environmentally compatible, and disposed of in a form that permits its long-term storage. Waste also arises out of the production of heat and electricity in nuclear power plants. Until the time when it can finally be disposed of in geological formations, existing radioactive waste



TRANSFER STATION
RAIL/ROAD

is collected and processed in preparation for its final disposal by being solidified, packed and isolated from the environment and human habitations through storage in the power plants' own interim facilities; since mid-2001, storage has also taken place in Zwilag's central interim storage facility at Würenlingen.

Interim storage facilities are needed because the radioactive waste generated by electricity production – the spent fuel elements and vitrified, highly radioactive waste – has to be stored above ground for some forty years due to the residual heat production during that time; after this, it can be permanently disposed of in deep geological formations.

CENTRAL INTERIM STORAGE WÜRENLINGEN

STORAGE FOR MEDIUM-LEVEL WASTE

TRANSFER OF A CASK TO THE HIGH-LEVEL WASTE STORAGE BUILDING

Zwilag Zwischenlager Würenlingen AG, founded in 1990, is owned by the Swiss nuclear power plant operators BKW FMB Beteiligungen AG, Kernkraftwerk Gösgen-Däniken AG, Kernkraftwerk Leibstadt AG and Axpo AG (formerly Nordostschweizerische Kraftwerke AG). The aim of the company is the operation of interim storage facilities and waste management plants for radioactive waste in Würenlingen, in the Swiss canton of Aargau.

1 CONDITIONING PLANT AND OFFICE BUILDING

2 STORAGE HALL FOR LOW- AND MEDIUM-LEVEL WASTE

3 STORAGE HALL FOR MEDIUM-LEVEL WASTE

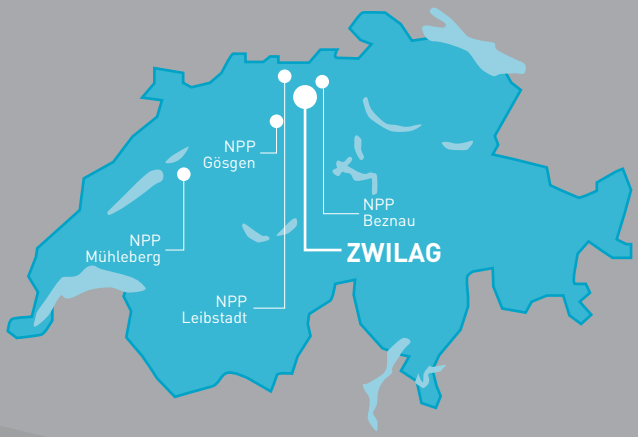
4 HOT CELL

5 RECEPTION BUILDING

6 CASK STORAGE BUILDING (HIGH-LEVEL WASTE)

7 PLASMA PLANT

8 AUXILIARY BUILDING



FUNCTION AND TASKS OF THE INTERIM STORAGE AT WÜRENLINGEN

In Switzerland, producers of radioactive waste are responsible for its safe disposal. The Swiss concept of radioactive waste disposal allows for its final storage in geological rock formations. The processing of the waste into a permanently storable form and its interim storage is the responsibility of the producer.

In addition to existing processing and interim storage facilities in the nuclear power plants and the Paul Scherrer Institute (PSI) Würenlingen, the Swiss nuclear power plant operators have established joint processing and storage premises next to the PSI's Eastside facilities (PSI-Ost) : this is Zwilag. Following a licensing process that took six years to complete, buil-

VIEW INTO THE CASK STORAGE HALL

ding began in late August 1996. The first construction phase came to an end in spring 2000, signalling the beginning of commissioning. The second phase, construction of the storage hangar for low- and medium-level radioactive waste, was completed in 2003.

Safety considerations during the planning of the site took into account even rare occurrences, such as airplane crashes or severe earthquakes. Moreover, thanks to the strict safety precautions in place, there is no conceivable risk to the general public beyond its perimeter.

INTERIM STORAGE: HALFWAY BETWEEN PRODUCTION AND FINAL IN GEOLOGICAL FORMATIONS

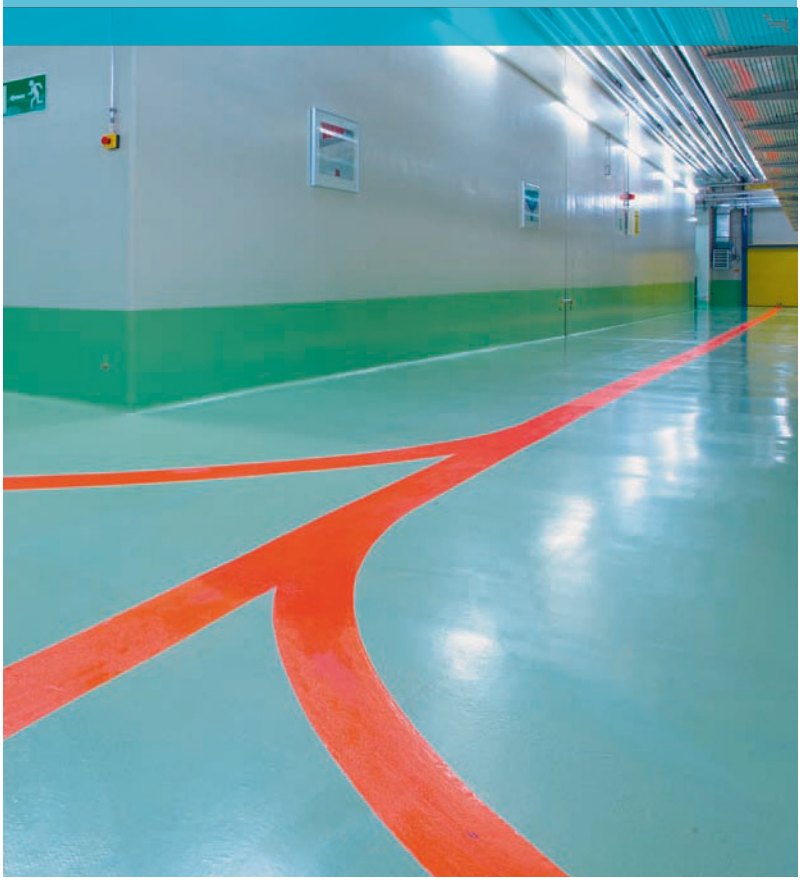
Zwilag's facilities and the PSI (the Swiss Confederation's interim storage facility) contain all category of waste from Swiss origin.

- **Operational waste and spent fuel elements from Swiss nuclear power plants.**
- **All categories of waste generated by the reprocessing of spent fuel elements from Swiss plants in foreign reprocessing facilities.**
- **Waste for which the Swiss Confederation is responsible, i.e. radioactive waste from medicine, industry and research.**

TRANSPORT TUNNEL BETWEEN CONDITIONING PLANT AND STORAGE BUILDINGS

STORAGE

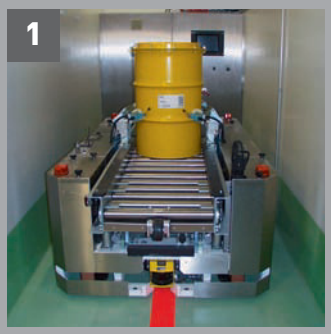
Siting Zwilag in Würenlingen next to the PSI (where the Swiss Confederation has been storing its radioactive wastes for many years) brings with it a number of advantages: the combined processing facilities and centralised storage facilities smooth the consolidation of the waste and minimise transport movements, thus providing further guarantees with regard to the monitoring and checking of the waste.

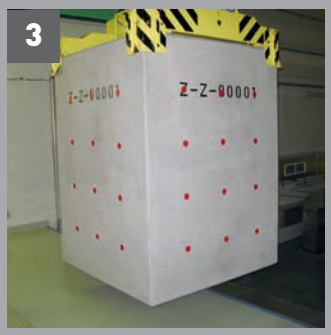


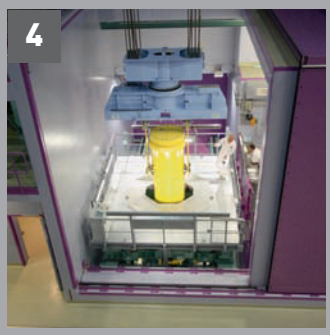
PROCESSING OF RADIOACTIVE WASTE

CHANGING ROOM

Waste processing at the Würenlingen central interim storage facility consists of raw low- and medium-level waste from the Swiss Confederation (generated by medicine, industry and research) and from nuclear power plants being conditioned into a form suitable for final disposal. The waste processing facilities comprise a reception zone with screening installations, a buffer store and laboratory, a conditioning section with decon-tamination and cementation facilities, as well as a separate plasma plant with off-gas treatment.







1 REMOTE TRANSPORT SYSTEM

2 RAW WASTE DRUMS

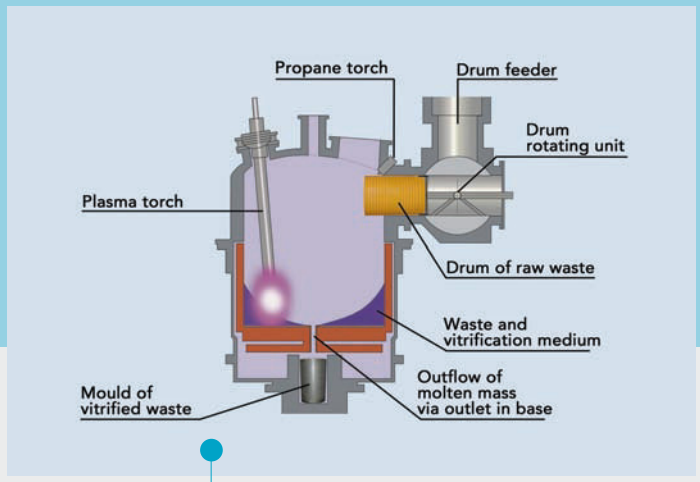
3 CONCRETE CONTAINER FOR LOW-LEVEL WASTE

4 CASK PREPARATION FOR LEAK RATE TEST

THE PLASMA PLANT: A MILESTONE IN NUCLEAR WASTE DISPOSAL

PLASMA PLANT

Zwilag's high-powered plasma plant is the first in the world to be used to process or melt low-level radioactive waste at several thousand degrees celsius. First seen in metallurgy, the plasma process permits both the processing of combustible materials and the melting of metallic parts or concrete. By means of this process, the 200-litre drums containing raw waste are conveyed by remote control to the furnace's drum feeder system. Right at the start, the medium required for vitrification (waste glass) is fed into the furnace. The 1200 kW plasma torch then melts down the waste and the glass together by means of an arc that is surrounded by an extremely hot flame some 5 to 15 cm thick; nitrogen being used as the plasma gas. The plasma arc can be imagined as a permanent lightning. During



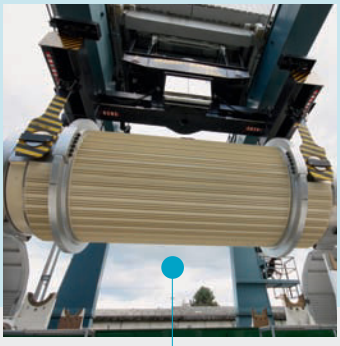
FUNCTION OF THE PLASMA PLANT

the melting process, the furnace is rotating around its vertical axis. By reducing the speed of rotation – and once the bottom outlet has been opened – the melt is poured into a steel mould and, after it has cooled down and solidified, is placed in prepared waste packages for interim storage.

The use of glass in the process results in a waste matrix that is highly chemical- and leach-resistant and which possesses optimal properties for its later storage in geological formations.

LONG EXPERIENCE IN TRANSPORTATION AND HANDLING

HEAVY DUTY TRAILER



CASK UNLOADING

Specially equipped road-going trailers and trains are used to transport the radioactive material in special flasks, the transfer of the material between rail and road being carried out at a transfer station. These shipments are regulated by national and international laws, regulations, agreements and guidelines, and are subject to detailed supervision. Authorisation must be detained for each individual shipment, and only flasks licensed by the authorities may be used.

The thick-walled flasks used for transporting and storing the highly radioactive vitrified waste and spent fuel elements can weigh up to 140 tons: they serve to protect the contents in the event of a severe accident while in transit, or other incidents. They are submitted to stringent testing.

HIGH RISE
STORAGE FOR
RAW WASTE

STORAGE CONTAINER
FOR LOW- AND
MEDIUM-LEVEL WASTE

For instance, in safety tests a flask has to withstand a drop from nine meters on to a hard surface and a steel pin, and is submitted to a fire exposure test with an average flame temperature of at least 800 °C.

Before going into interim storage, the waste is checked and logged. The waste at Zwilag remains in possession of the supplier, who is ultimately responsible for its long-term disposal in deep geological formations at a later date.

Zwilag makes use of an airplane crash-tight 'hot cell' to monitor the flasks containing the vitrified, highly radioactive waste and spent fuel elements if needed.

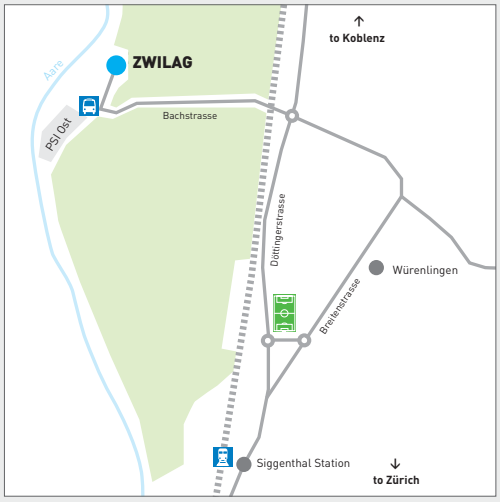
STORAGE CAPACITY SUFFICIENT FOR DECADES

Various buildings are available for the interim storage of radioactive waste and spent fuel elements.
The flask storage hangar is where the highly radioactive, vitrified waste and spent fuel elements are temporarily stored in special thick-walled, sealed flasks used for transport and storage: they can weigh up to 140 tons. The flask seals are permanently monitored throughout the time the flasks remain in storage.
Heat is released as radioactivity decays. The heat emitted by low-level radioactive waste is so low that it is nearly undetectable. Highly radioactive waste releases considerably more heat, but this drops continously as the radiation decays, so that the waste can be stored in geological formations after some 40 years. Natural convection cooling is used to cool the flasks containing the highly radioactive waste and spent fuel elements: fresh air

STORAGE OF LOW- AND MEDIUM-LEVEL WASTE

flows into the hangar through openings in the walls, rises up the outside of the flasks and transports the heat away through openings in the roof, without itself becoming radioactive.
The waste drums in the storage hangar for medium-level radioactive waste are stored in pits. The largest hangar, which, at 98 meters long, is destined to hold low- and medium-level radioactive waste, will not be needed for radioactive waste for the next few years.
Thanks to sufficient interim storage capacity, there is enough time to prepare the long-term storage facilities in geological formations without any time pressure.

HOW TO GET THERE



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