POLITECHNIKA GDAŃSKA
WYDZIAŁ ELEKTROTECHNIKI I AUTOMATYKI

NUCLEAR POWER

LECTURE 7

Gdańsk 2018

NUCLEAR POWER – LECTURE 7

1. Radioactive waste, classification, conditioning
2. Barriers to prevent the spread of radioactive substances
3. Storage of radioactive waste

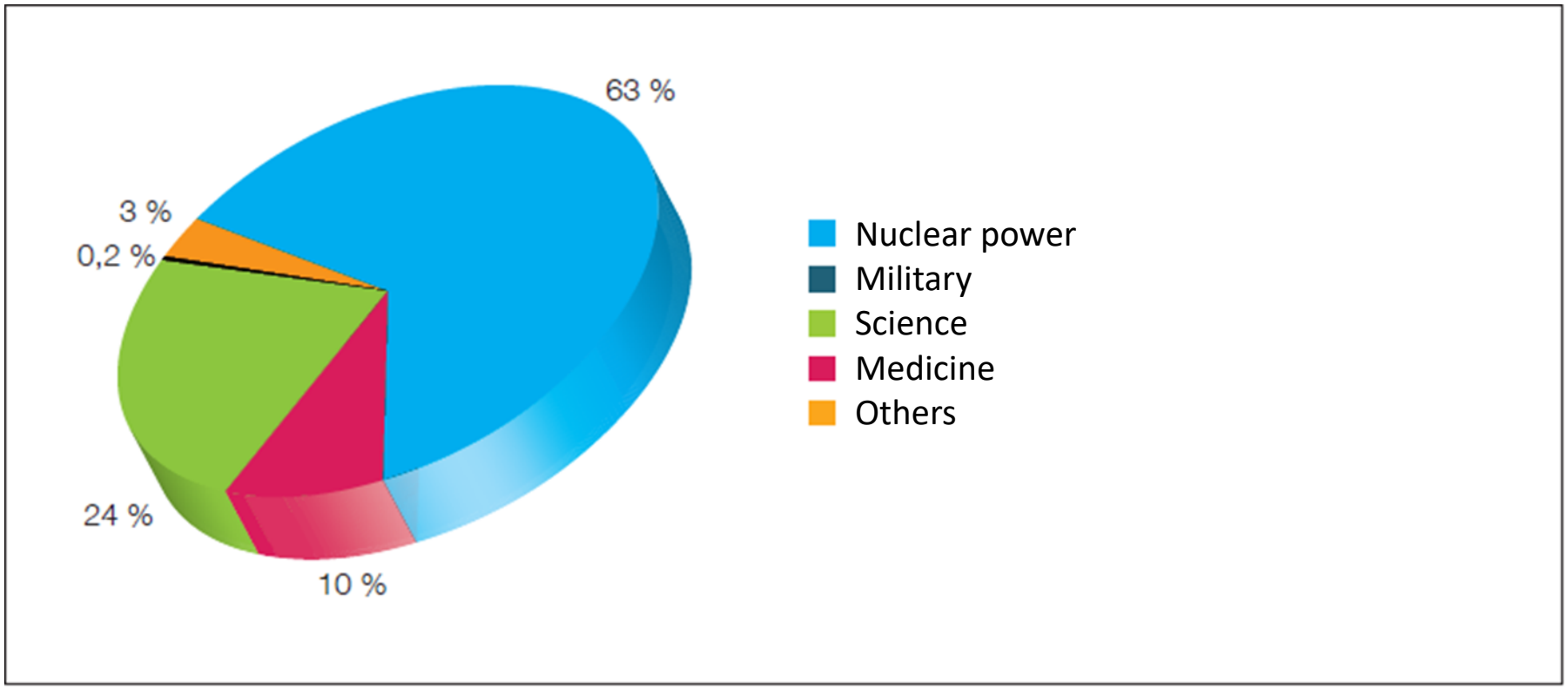
RADIOACTIVE WASTE

Radioactive waste:

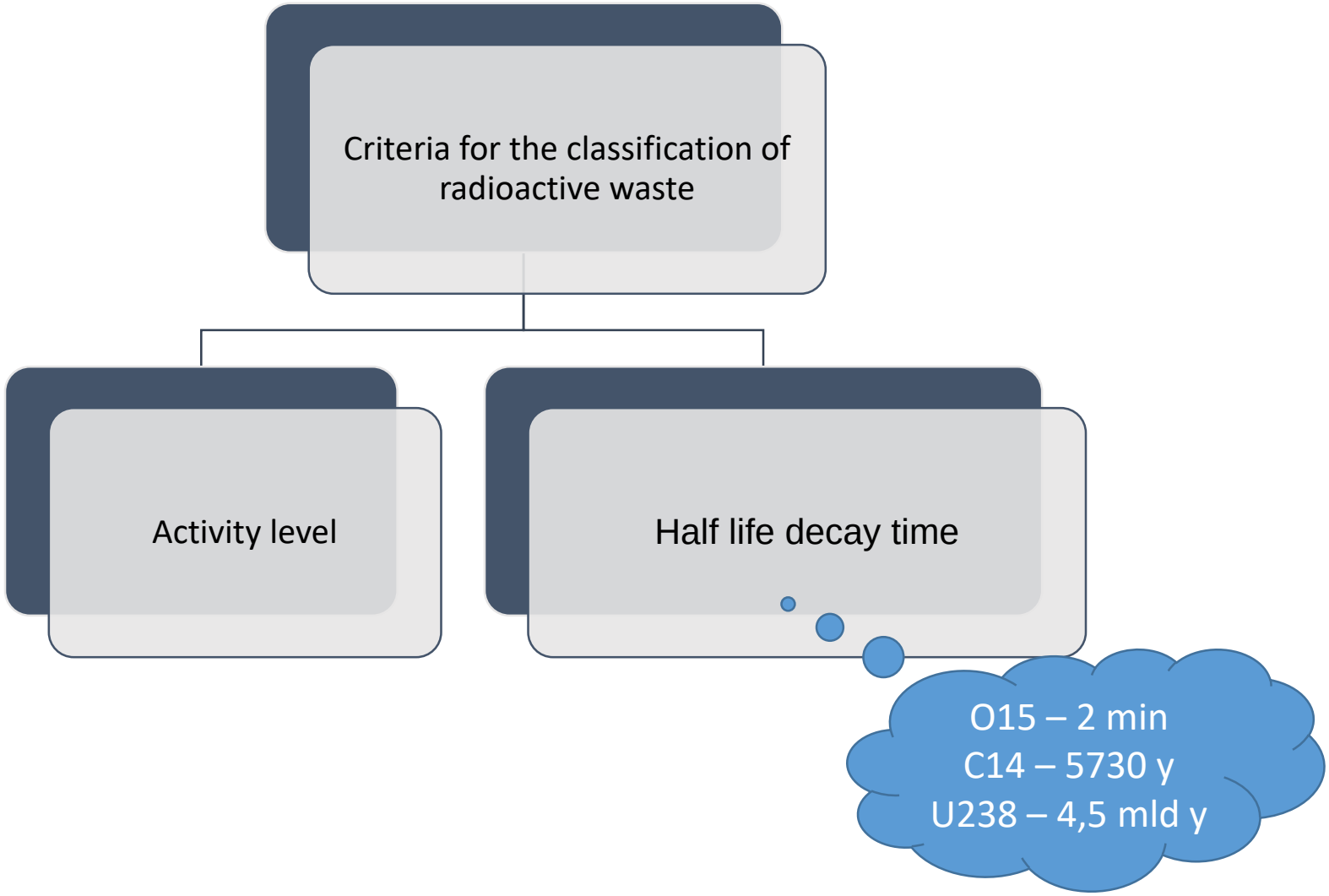
According to the IAEA, waste is treated as radioactive and may be subject to separate regulations if its level of activity exceeds the level of permissible natural radioactivity.

RADIOACTIVE WASTE

Where do radioactive waste come from?

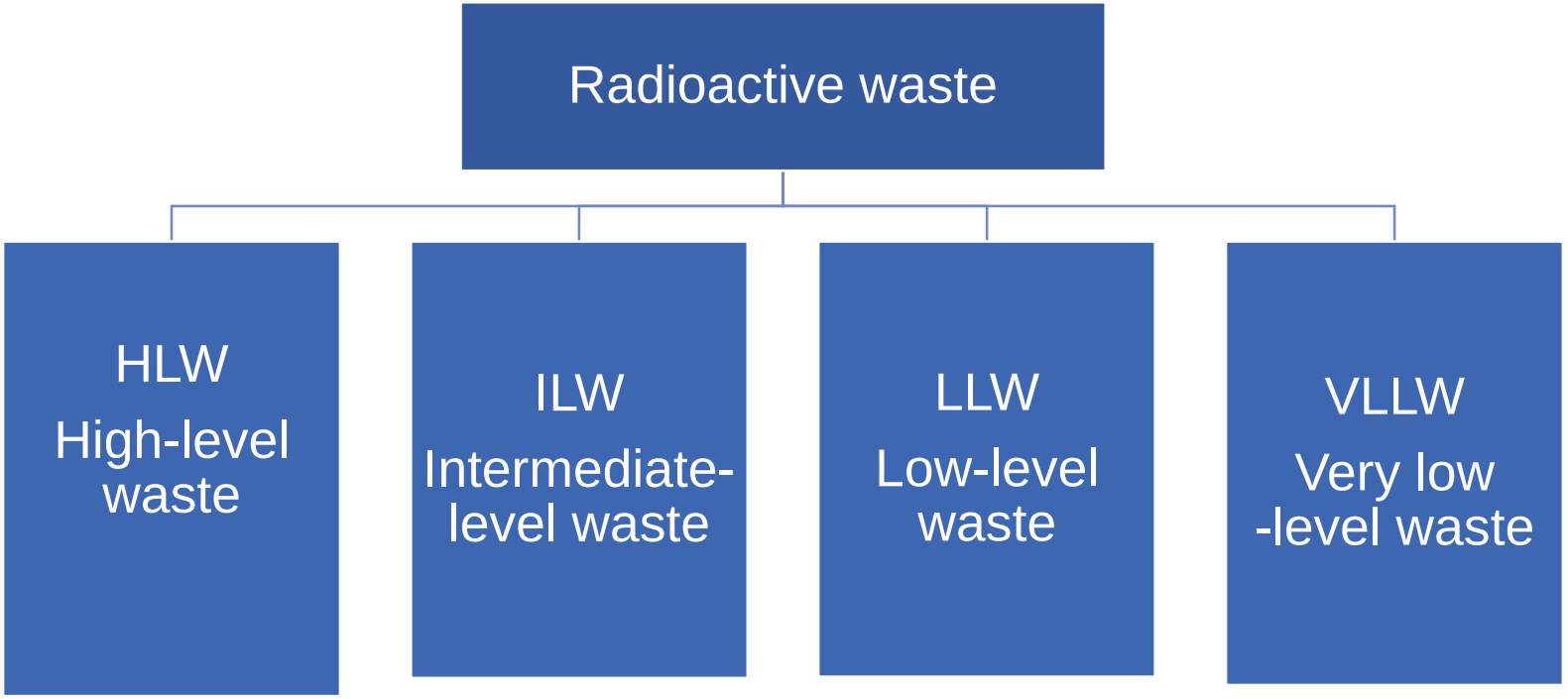


RADIOACTIVE WASTE

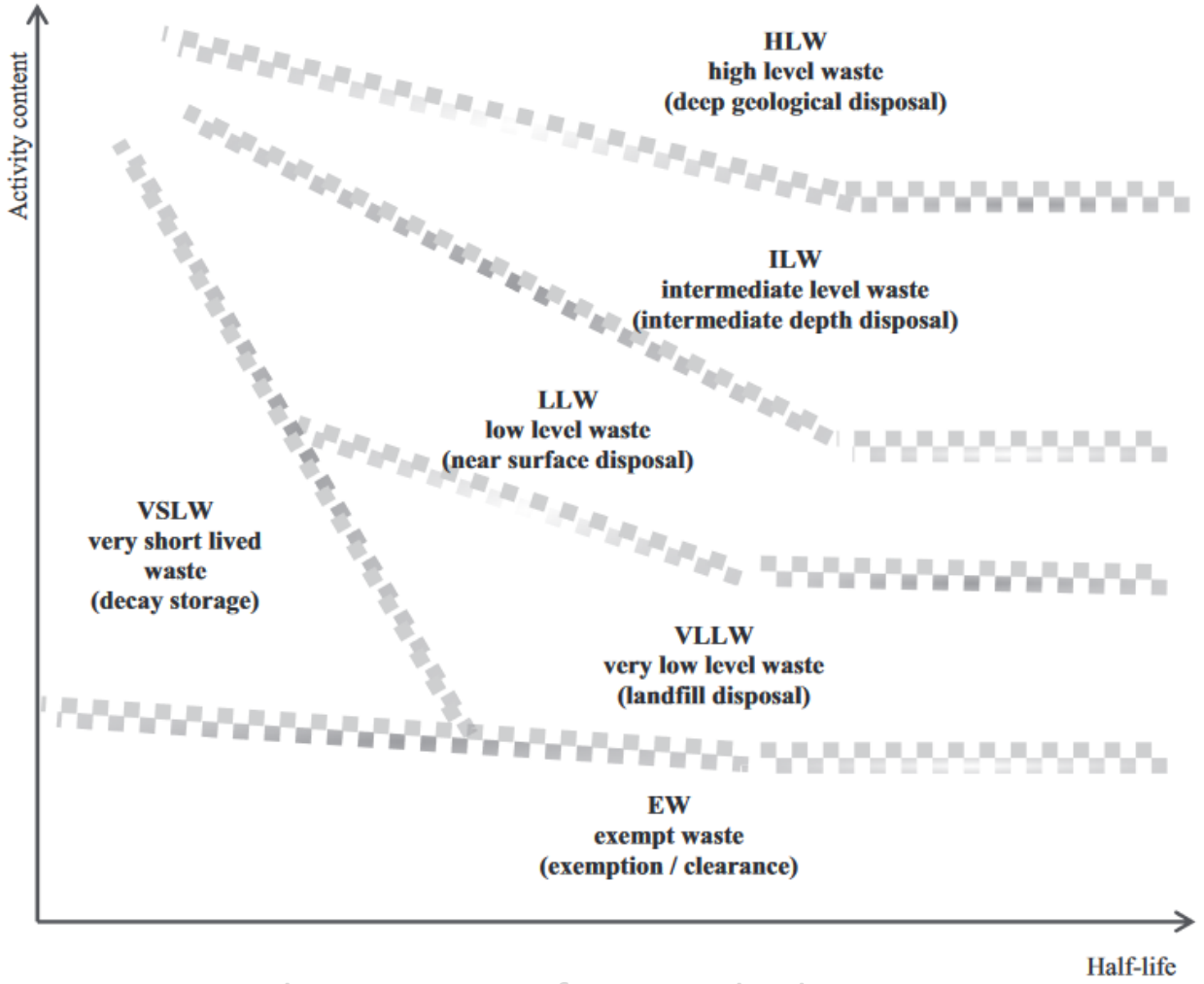


RADIOACTIVE WASTE

There are 4 classes of waste depending on the intensity of their radioactivity :

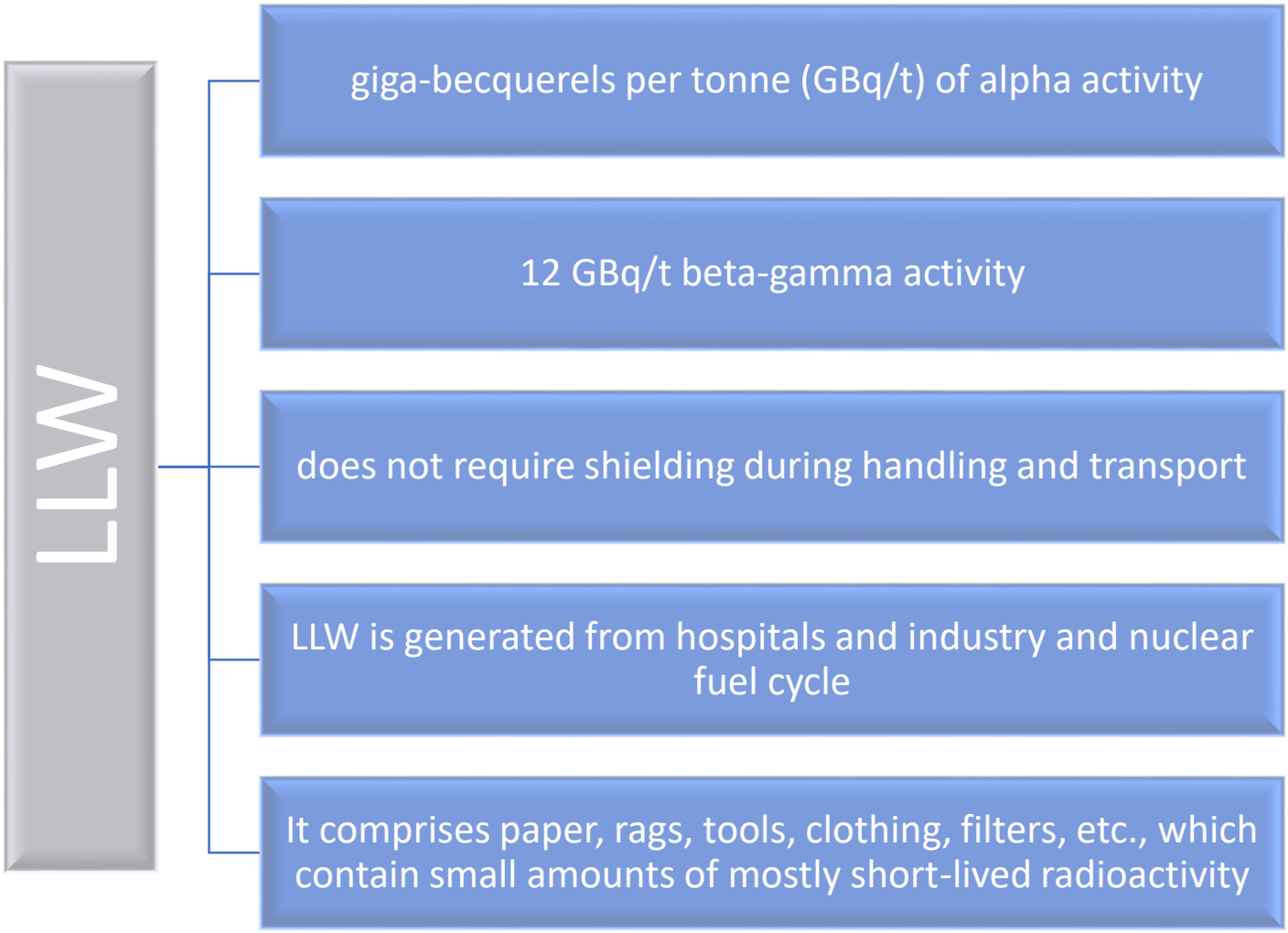


RADIOACTIVE WASTE

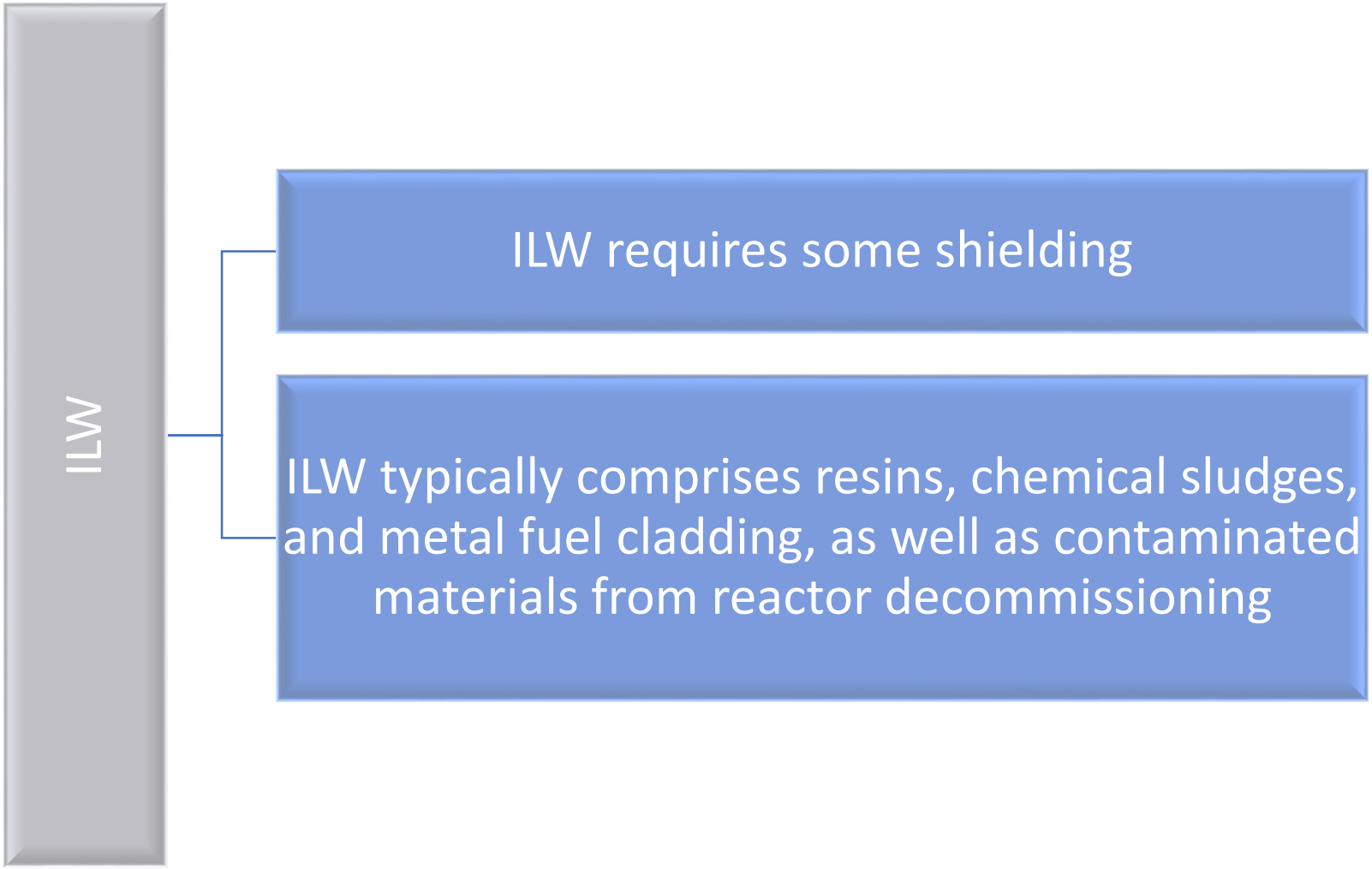


according to IAEA Safety Standards

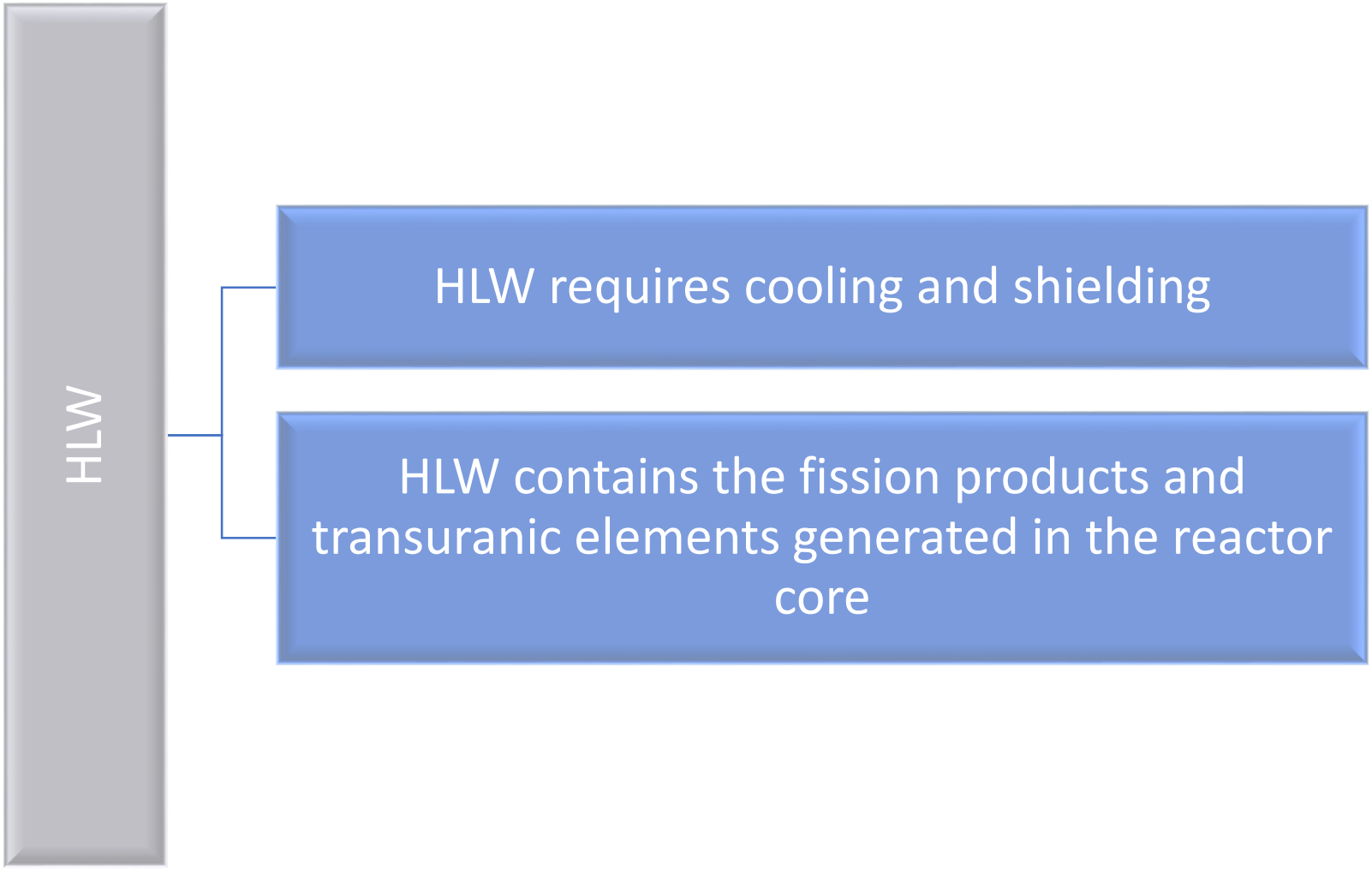
RADIOACTIVE WASTE



RADIOACTIVE WASTE



RADIOACTIVE WASTE



RADIOACTIVE WASTE

VLLW

It consists mainly of demolished material (such as concrete, plaster, bricks, metal, valves, piping, etc.) produced during rehabilitation or dismantling operations on nuclear industrial sites.

TREATMENT AND CONDITIONING OF NUCLEAR WASTE

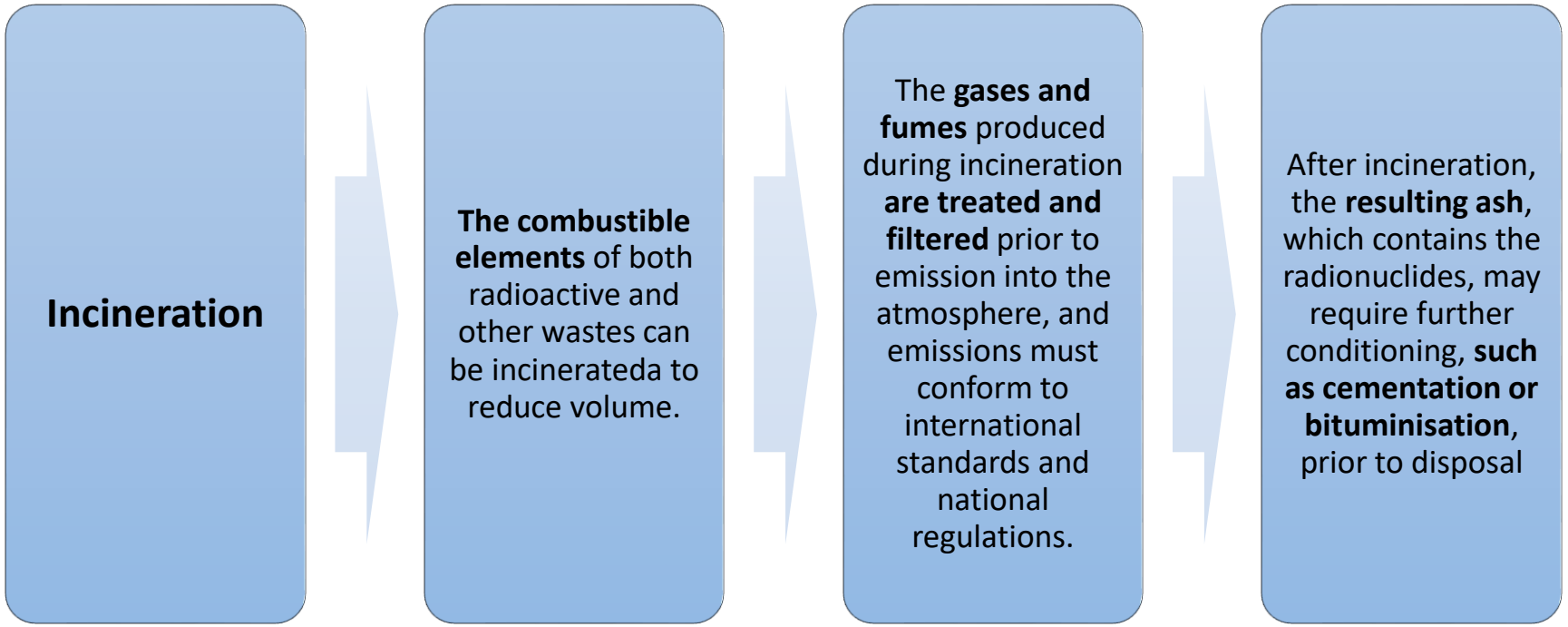
Treatment and conditioning processes are used to convert a wide variety of radioactive waste materials **into forms that are suitable** for their subsequent **management, including transportation, storage and final disposal**.

Minimize the volume of waste requiring management via treatment processes.

Reduce the potential hazard of the waste by conditioning it into a stable solid form that immobilises it and provides containment.

TREATMENT AND CONDITIONING OF NUCLEAR WASTE

TREATMENT AND CONDITIONING OF NUCLEAR WASTE



TREATMENT AND CONDITIONING OF NUCLEAR WASTE

Compaction

Compaction is a straightforward means of **reducing waste volumes** and is used for processing mainly solid industrial

http://www.world-nuclear.org

TREATMENT AND CONDITIONING OF NUCLEAR WASTE

Vitrification

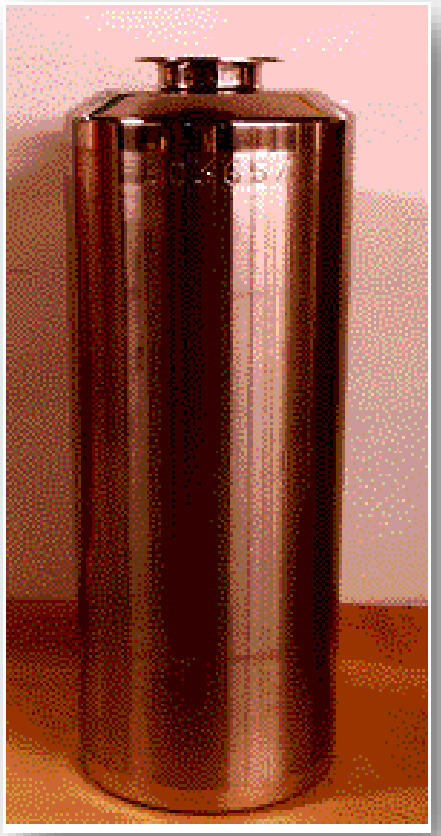
The immobilisation of HLW requires the formation of an insoluble, solid waste form that will remain **stable for many thousands of years**.

In general **borosilicate glass** has been chosen as the medium for dealing with separated HLW.

The stability of ancient glass for thousands of years highlights the suitability of borosilicate glass as a matrix material.

This process is currently being used in France, Japan, Russia, UK, and USA

Vitrification create a barrier to prevent further spread of contamination



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TREATMENT AND CONDITIONING OF NUCLEAR WASTE

Moving a radioactive waste container (CBFK) at the waste crushing department at the AREVA plant in Marcoule, France.
Copyright AREVA / G. Carillo

Standard containers for vitrified waste and solidified waste (high-level, long-lived waste). Copyright AREVA. Capacity: 155 liters; weight: 490 kg; height: 1.3 m; Diameter: 43 cm.

TREATMENT AND CONDITIONING OF NUCLEAR WASTE

Engineered encapsulation

Where used fuel is not reprocessed to recycle its useful constituents, after long storage and before disposal it is encapsulated.

The fuel itself comprises stable ceramic fuel pellets inside tubes.

Before disposal these are put into large metal canisters about five metres long to provide additional containment., each holding about 12 fuel assemblies.

http://www.world-nuclear.org

TREAMENT AND CONDITIONING OF NUCLEAR WASTE

The first time vitrification was made in 1969 in **CEA in Marcoule**, France.

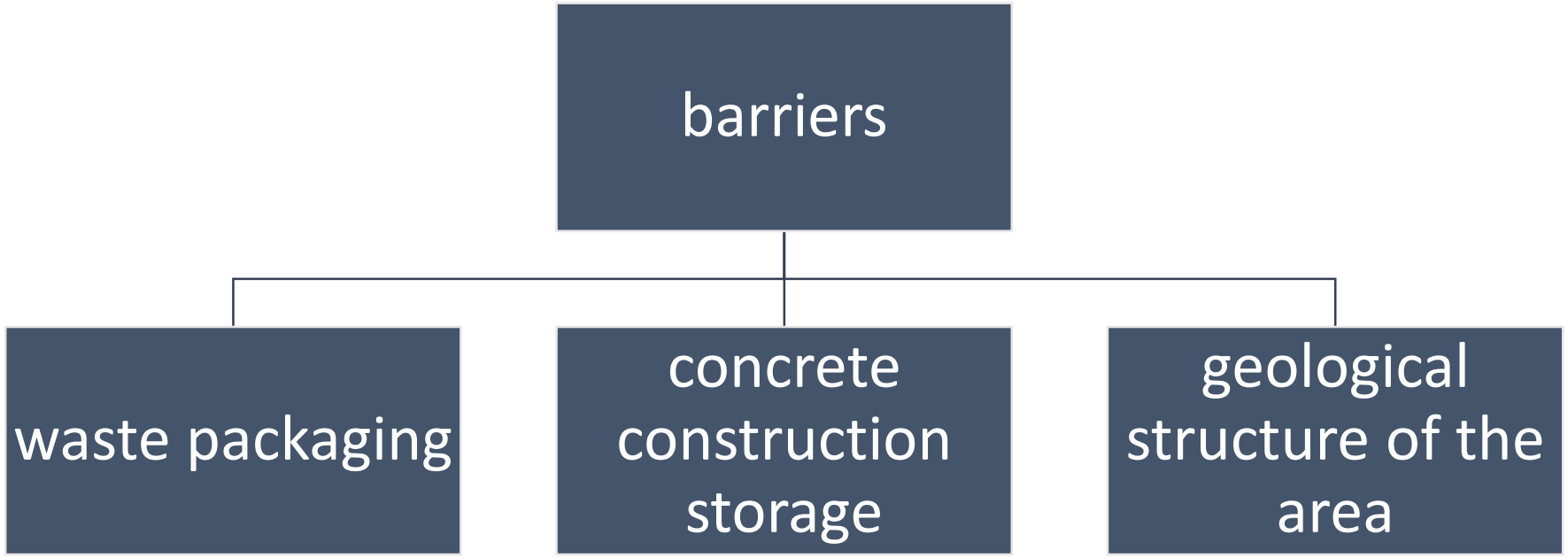
Since this time all **HLW and long-life west** are being conditioned in this way.

TREAMENT AND CONDITIONING OF NUCLEAR WASTE

Metal barrels with low-active short-lived radioactive waste. Copyright ANDRA. Capacity: 205 liters; weight: 430 kg; height: 80 cm; diameter: 60 cm.

Big bag sacks for very low-level waste. Copyright ANDRA, les films Roger Leenhardt

BARRIERS TO PREVENT THE SPREAD OF RADIOACTIVE SUBSTANCES



TREAMENT AND CONDITIONING OF NUCLEAR WASTE IN POLAND

The neutralization of radioactive waste in Poland is carried out by the **Radioactive Waste Utilization Plant (ZUOP) in Świerk**, which provides: collection; transport; periodic storage; processing; solidification; storage of radioactive materials.

STORAGE OF RADIOACTIVE WASTE

Radioactive waste in Poland is stored on the territory of the **National Radioactive Waste Repository (KSOP)** operating since 1961 in Różan on the River Narew.

STORAGE OF RADIOACTIVE WASTE

The storage site is intended for storing short-lived low- and intermediate-level waste and for periodic storage of long-lived waste.

Around the western and southern borders of the National Radioactive Waste Repository in Różan there is a dry moat with a depth of (2 ÷ 6) m, the fragment of which is shown in Fig.

STORAGE OF RADIOACTIVE WASTE

At **KSOP**, waste can only be stored in solid or solidified form.

Long-lived alpha-radioactive waste is stored in concrete fortification chambers. Thickness of walls and ceilings - in the buildings they are 1.2 - 1.5 m, which ensures full biological cover of the waste placed in them.

Long-lived waste in the chamber of object No. 1

STORAGE OF RADIOACTIVE WASTE

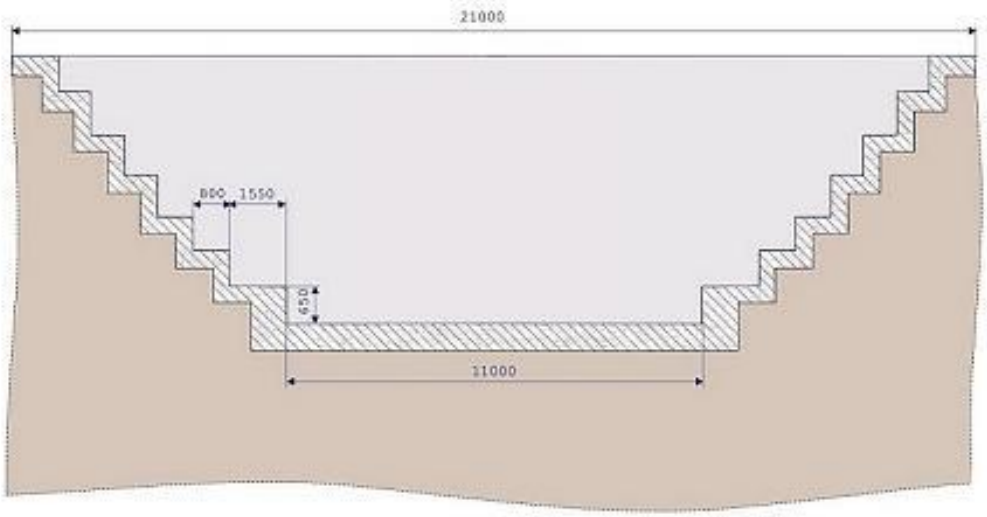
Containers with closed radium sources withdrawn from use

The place of storage of short-lived low- and intermediate-level waste is also a part of the dry moat adapted for this purpose.

The bottom and sides of the moat are covered with a 20 cm layer of concrete. Solid and solidified waste in two-sided galvanized metal drums are placed in a moat in layers. Then, they are flooded with concrete with the addition of bentonite, which - due to its sorption properties, supports the effectiveness of waste isolation.

STORAGE OF RADIOACTIVE WASTE

Obecnie eksploatowany obiekt nr 8



Przekrój obiektu nr 8 (fosa zachodnia)

The last, highest located waste is covered with a 40 cm layer of concrete - and impregnated with a bituminous mixture limiting the possibility of infiltrating rainwater into the interior of this structure.

STORAGE OF RADIOACTIVE WASTE

The effectiveness of applied safeguards (barriers) is systematically checked by controlling:

radiological exposure of employees based on individual measurements

radioactivity of basic elements of the natural environment (air, water, soil, vegetation),

radiation levels in the area and the surroundings of the landfill

STORAGE OF RADIOACTIVE WASTE

To ensure maximum objectivity of radiological examination of the environment, they are conducted by units independent of the operator of the Radioactive Waste Utilization Plant:

- Laboratory of Dosimetric Measurements at the Institute of Atomic Energy,
- Central Laboratory for Radiological Protection,
- Institute of Nuclear Physics commissioned by the National Atomic Energy Agency
- Nuclear supervision of the National Atomic Energy Agency,
- Polish Geological Institute.

STORAGE OF RADIOACTIVE WASTE

Landfill for low-level waste in the French region of France
(photo: CEA, source: IAEA)

STORAGE OF RADIOACTIVE WASTE

Landfill of intermediate activity waste (ILW) in Sweden (image: Bengt O. Nordin, Stockholm, Sweden, source: IAEA)

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Thank you for your attention