ANDRA
French national radioactive waste management agency

Challenges in Radioactive Waste Management

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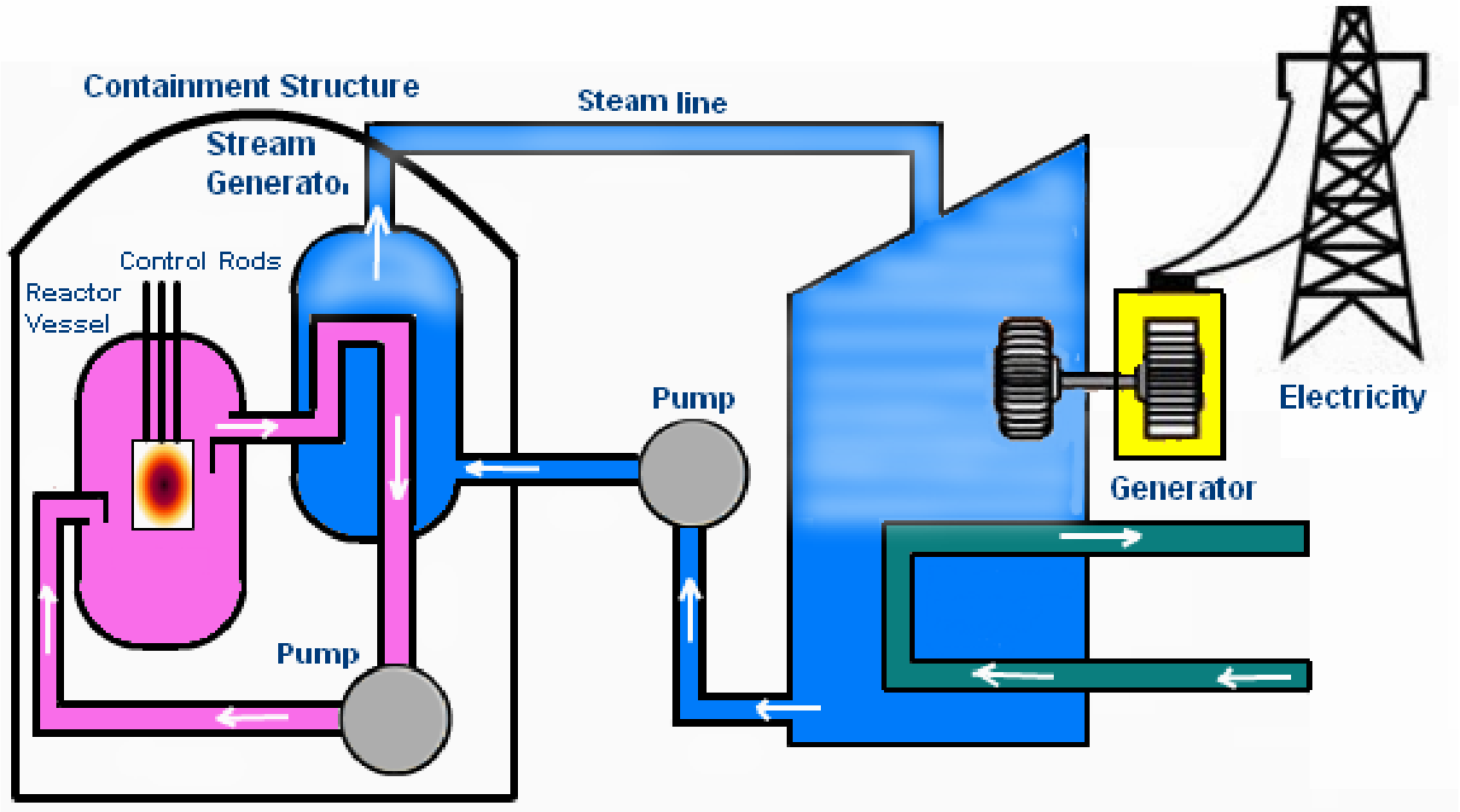
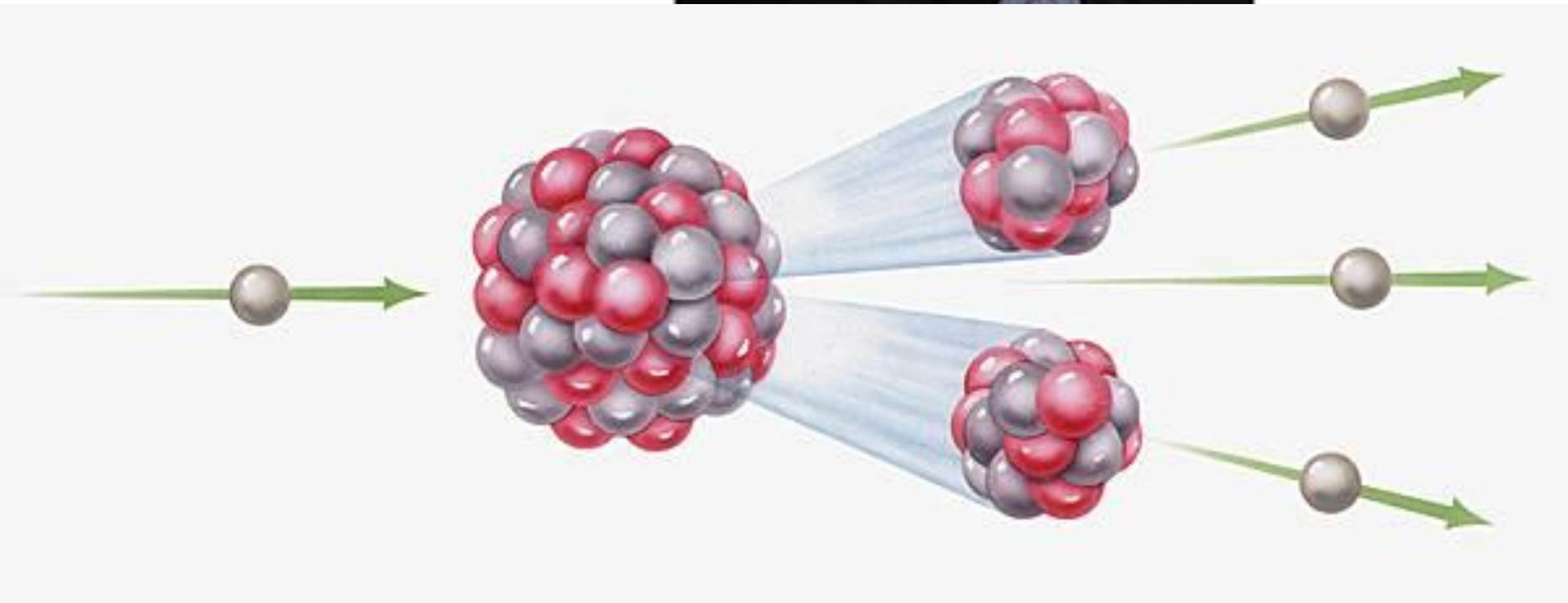
월드그린에너지포럼
WORLD GREEN ENERGY FORUM

Example of a Nuclear Pwer Plant

Nuclear power generation

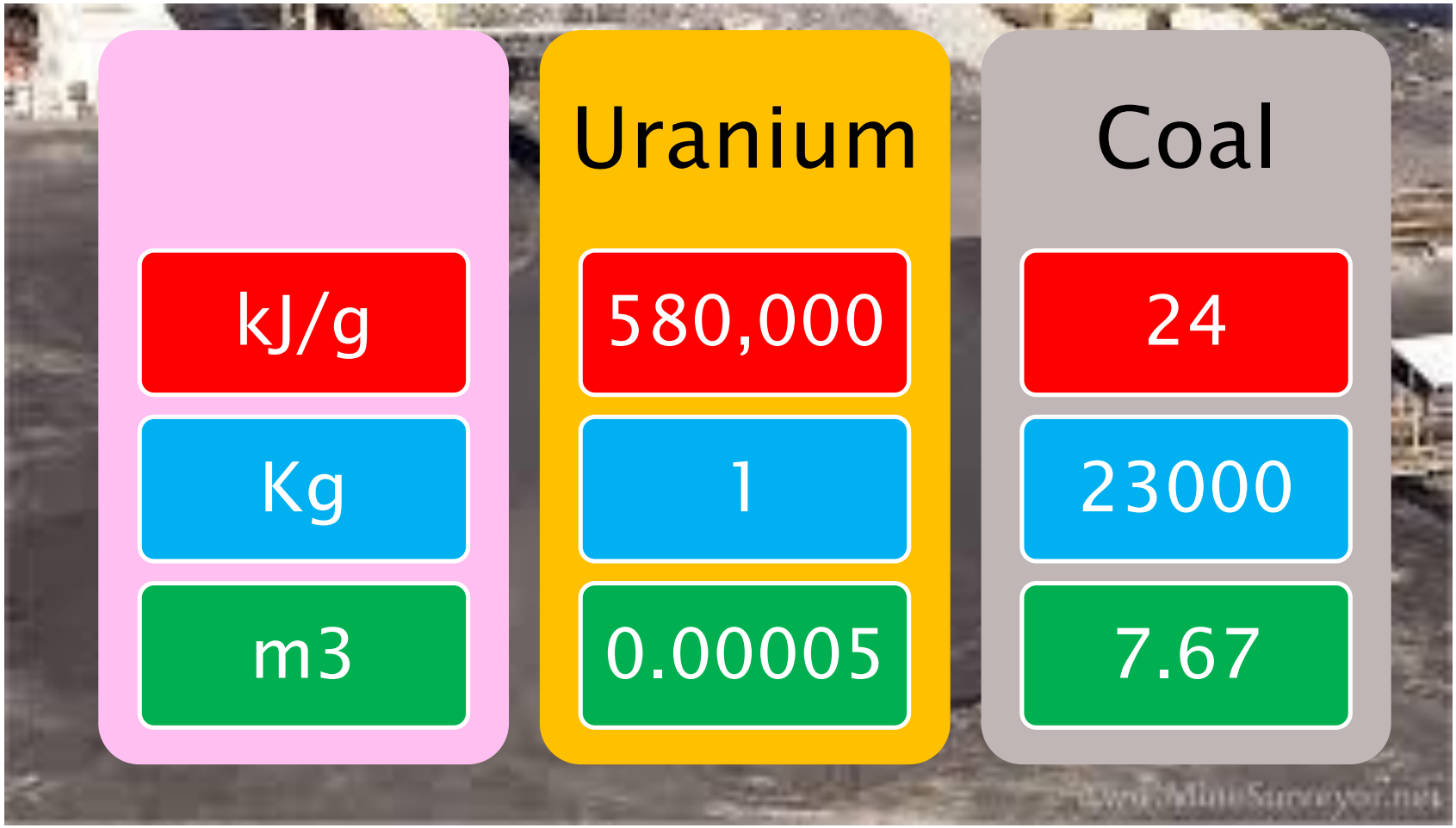


Fission reaction



Assemblage combustible

Power contained in uranium



	Uranium	Coal
kJ/g	580,000	24
Kg	1	23000
m3	0.00005	7.67

Nuclear fuel

U235
3%

U238
97%

FP & MA
4%

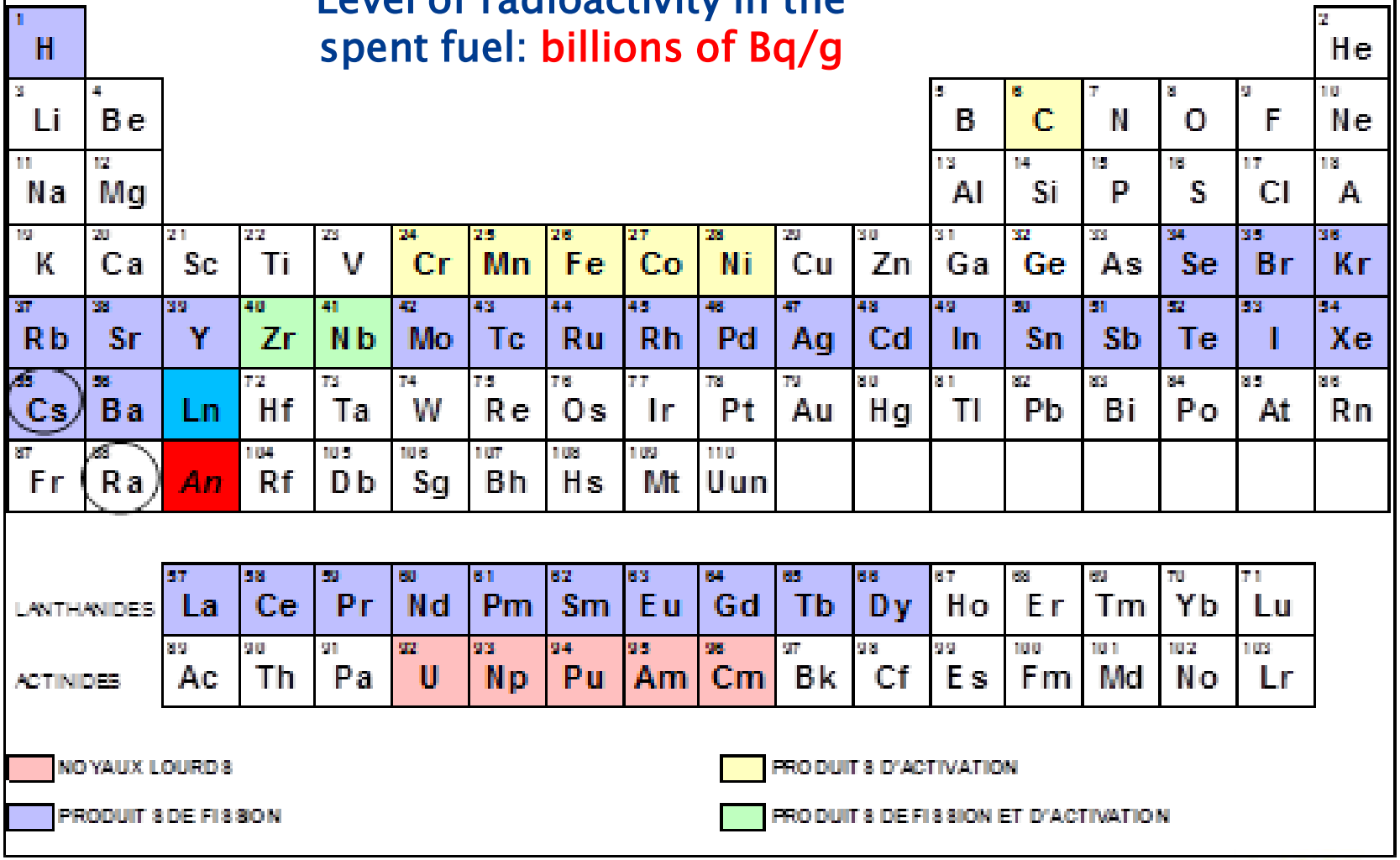
Pu 1%

U235 1%

U238
94%

Radionuclides in a spent fuel

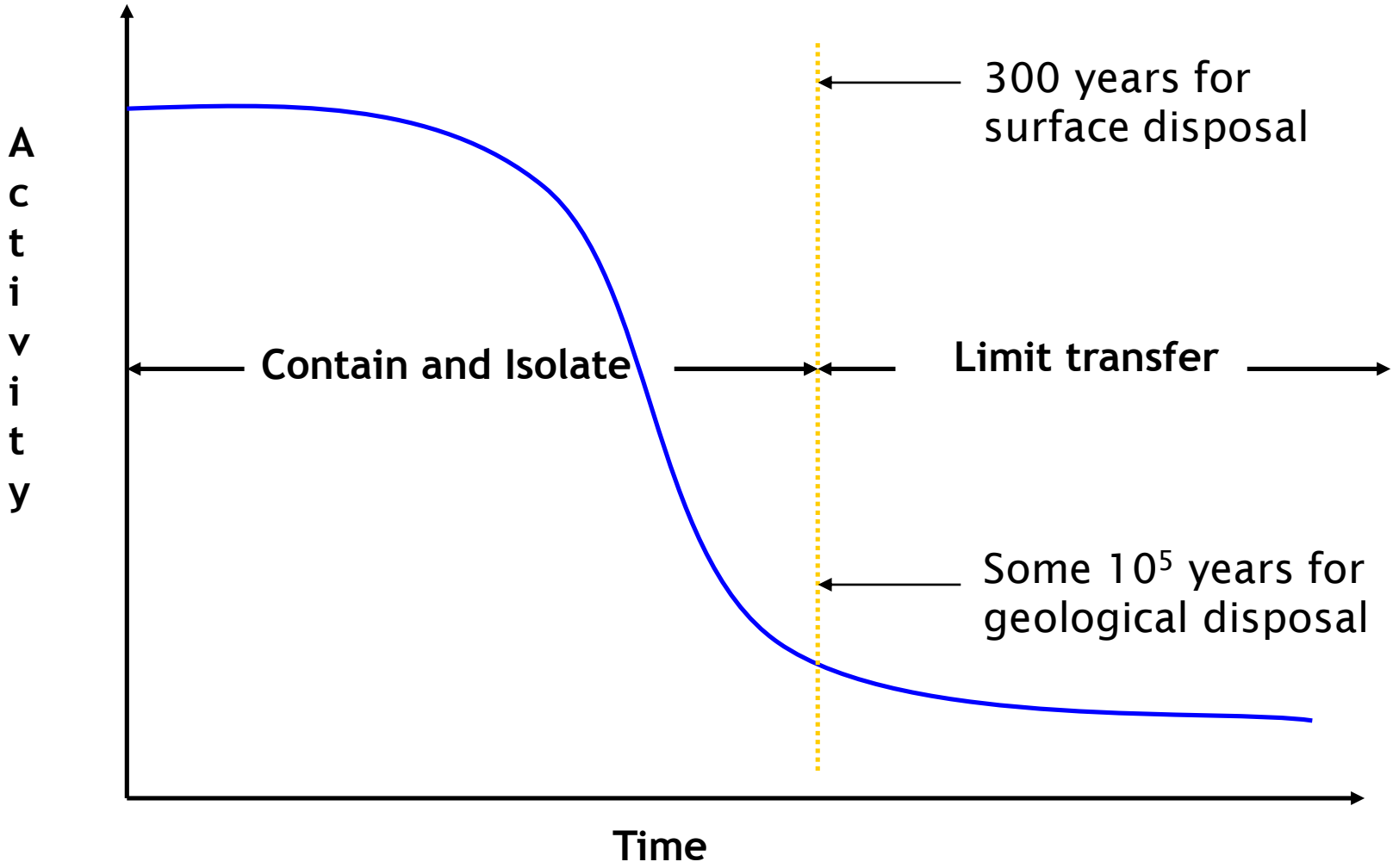
Level of radioactivity in the spent fuel: billions of Bq/g



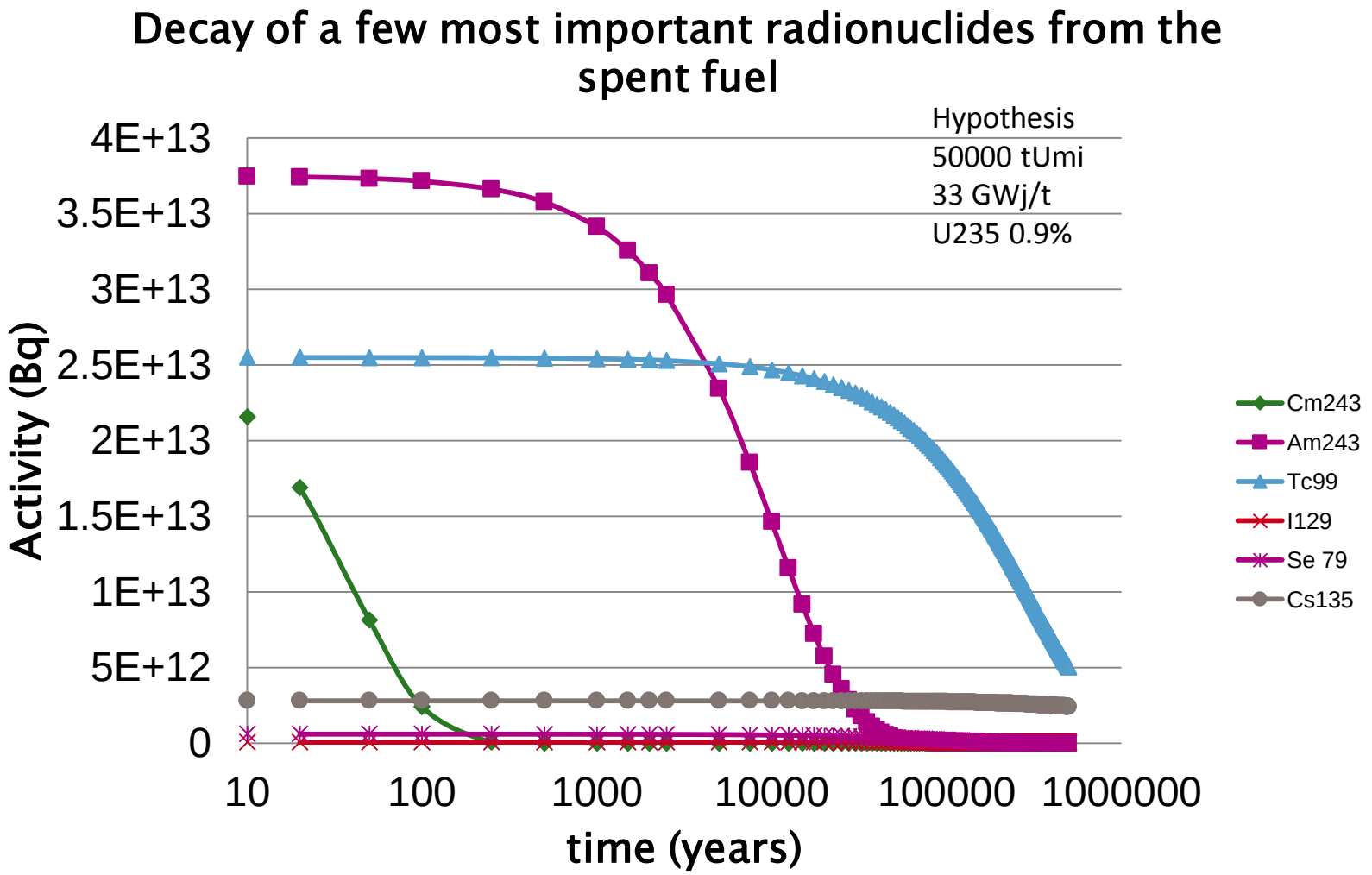
Risks associated with the high-level radioactivity wastes

- Radiological and chemical toxicity
  - Need for protecting man and its environment
- Criticity
- Terrorism and proliferation

Protecting man and its environment



Example of inventory for a nuclear fleet lifetime



Other risks

- Criticity
- Terrorism and proliferation

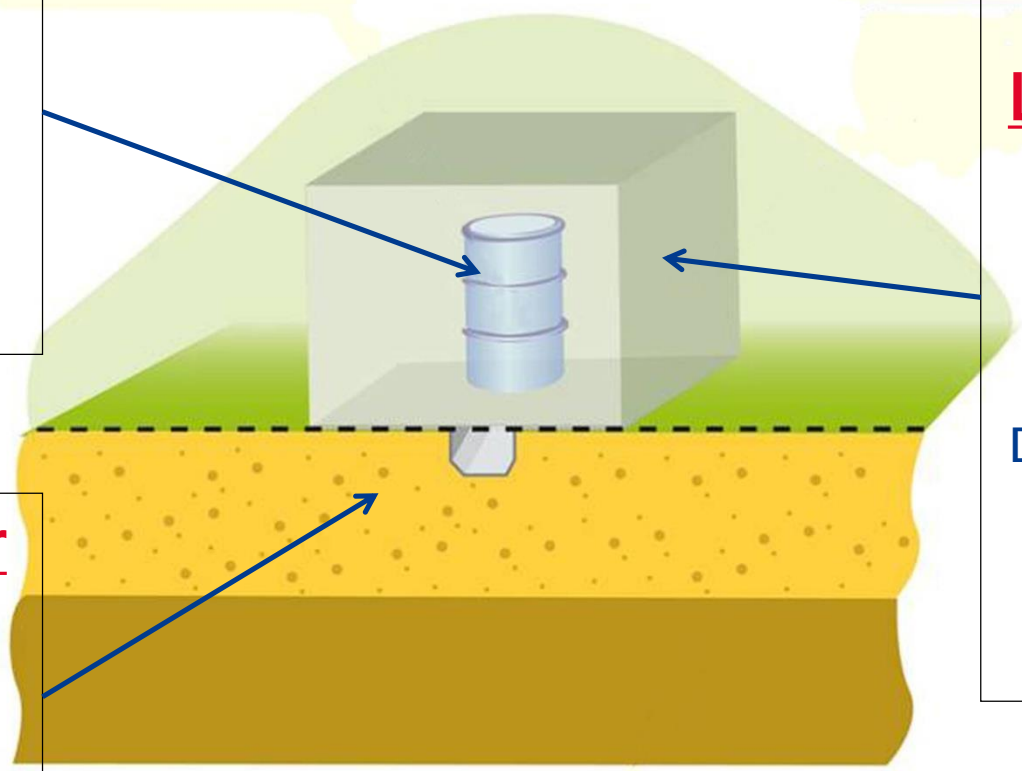
Safety functions and confining barriers

Contain and isolate

The waste package
⇔ 1rst barrier

Limit transfer

The site – geology
⇔ 3rd barrier



Contain and isolate
Limit transfer

The engineered system
Disposal cells and capping

⇔2nd barrier

Available technologies

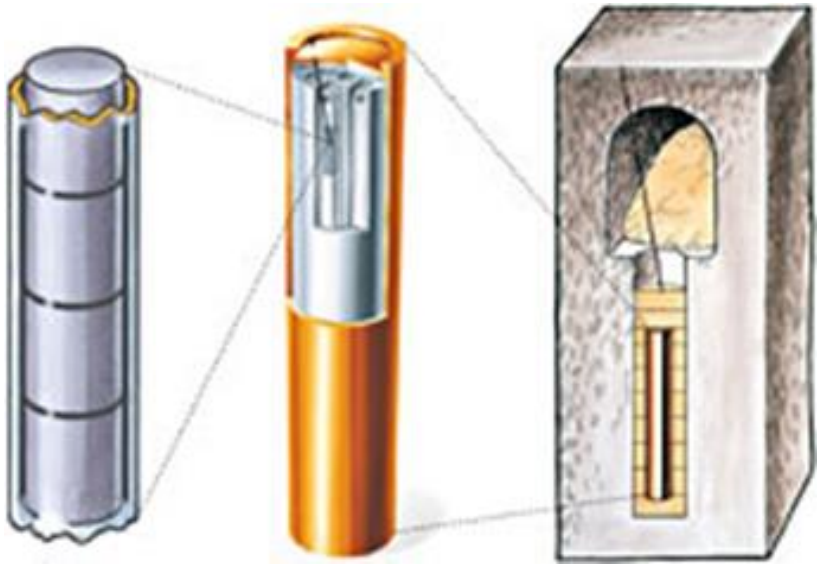
- 1st barrier: wastes and waste forms already exist
  - Spent fuels when considered as a waste
  - Vitrified waste and metallic structures when processed
  - ↳ **Characterisation**

- 3rd barrier: geological formations
  - Crystalline, typically granite
  - Sedimentary, clay, but also salt or limestone
  - ↳ **Knowledge and understanding of the natural system**

- 2nd barrier: engineered system
  - ↳ **To be designed**

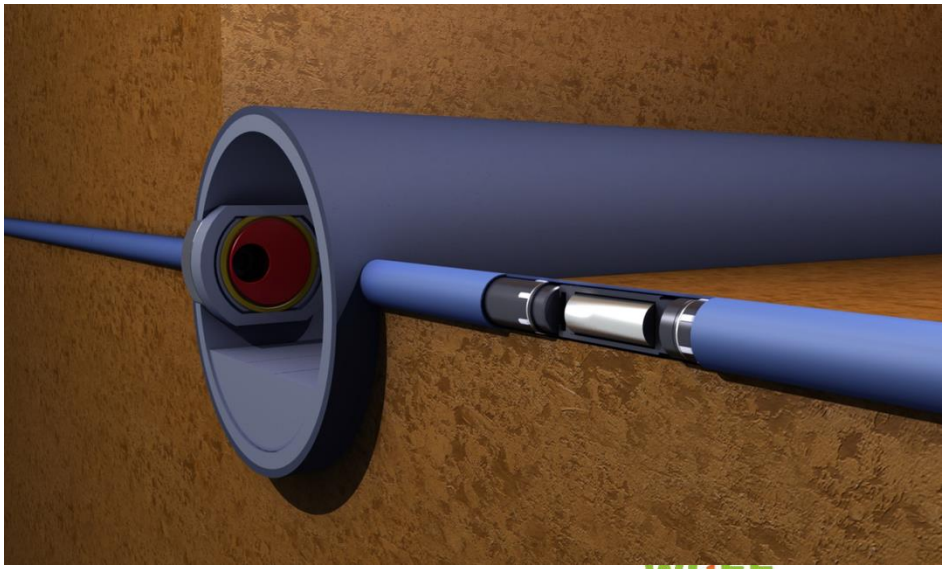
➲ **Full system performance to be assessed**

Examples of geological disposal systems



The KBS3 concept (Sweden)

- Waste: Used fuel
- Package: Copper canister
- Engineered barrier: Bentonite
- Natural barrier: Granite

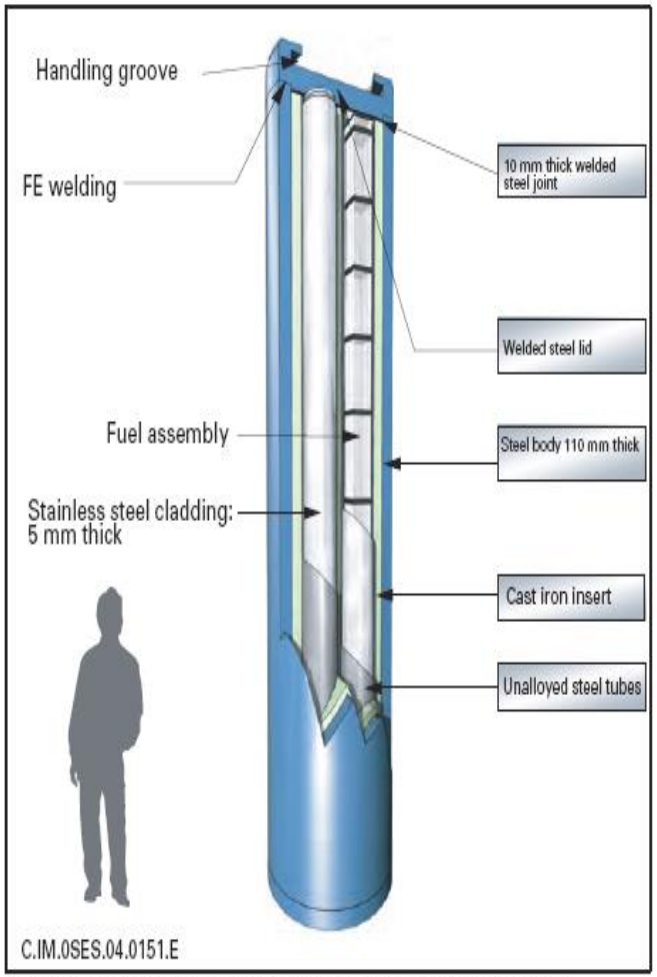


Cigéo (France)

- Waste: Vitrified residues
- Package: Iron
- Engineered barrier: concrete and bentonite
- Natural barrier: Clay

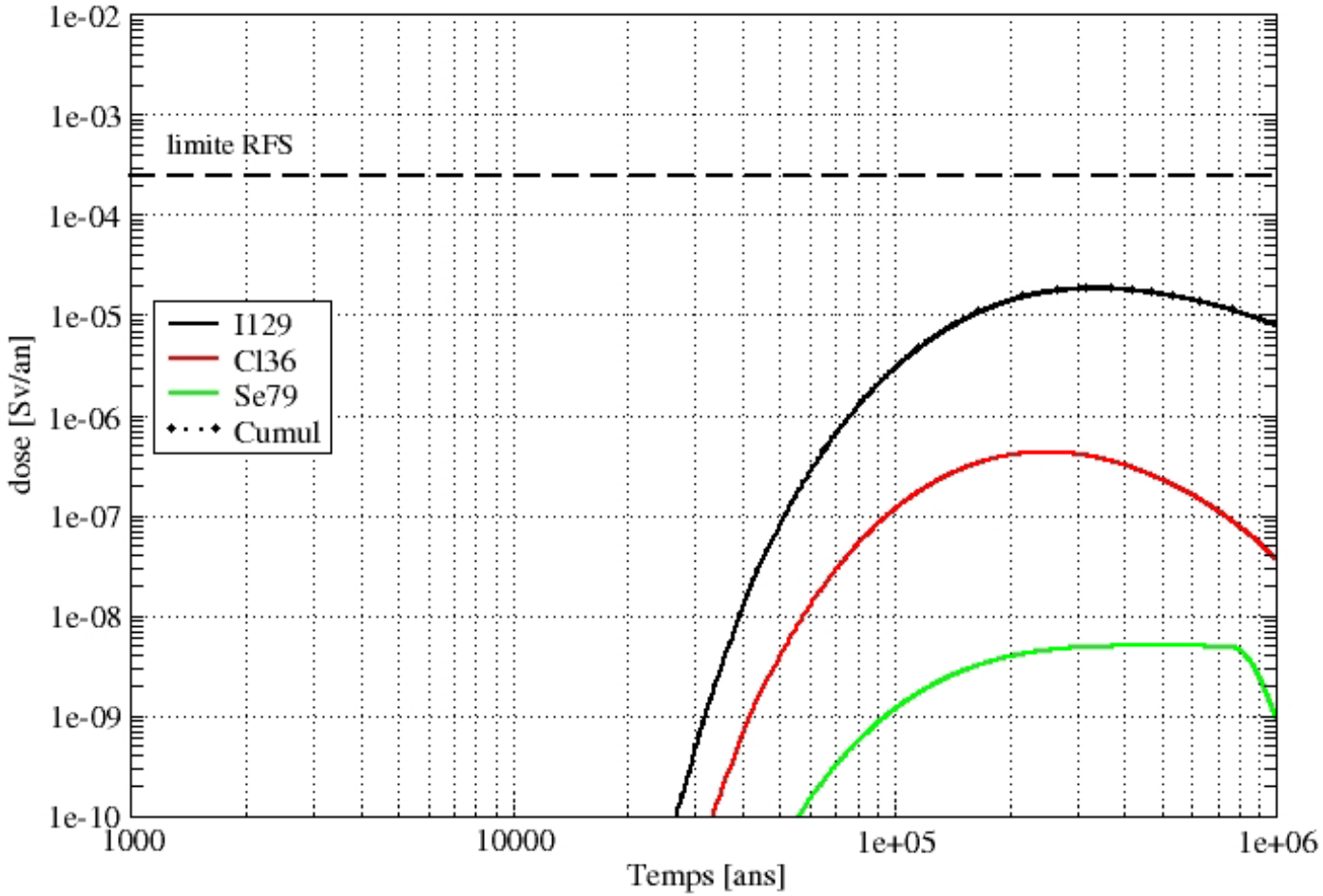
Improving safety conditions

- Limit the inventory
- Reduce the amount of attractive materials



Large diameter "four- assembly" package for spent fuel (UOX or URE)

On the long term



Societal challenges

- Monitoring
- Memory keeping

Conclusion

- Radioactive waste represents a major challenge for our environment
- Solutions exist for low-level activity waste
- Solutions are developed and are being implemented in the 2020s