Federal Office
for the Safety of
Nuclear Waste Management

Safeguards Requirements for the Disposal of High Active Waste in Germany in a Geological Repository

Safeguards

"Safeguards are a **set of technical measures** that are applied by the IAEA on **nuclear facilities and material**. Through these technical measures, the IAEA seeks to **independently verify** a State's legal obligation that nuclear **facilities are not misused** and **nuclear material is not diverted** from peaceful uses."

(emphasis added)

From: IAEA, Basics of IAEA Safeguards

https://www.iaea.org/topics/basics-of-iaea-safeguards,

By Rodolfo Quevenco/IAEA

https://www.flickr.com/photos/iaea_imagebank/4688155350/

Safety, Security & Safeguards in Final Disposal

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1. German regulation

“The safety concept shall take into account measures [...] for nuclear material safeguards.”

(own translation from EndlSiAnfV, § 10 par. 7 no. 2)

2. International safety standards

Placement in a geological disposal facility […] would be consistent with the objective of IAEA nuclear safeguards.

“[…] **Intrusive methods, which might compromise safety after closure, have to be avoided.**“

Clauses 5.15. & 5.18, IAEA SSR-5, Disposal of Radioactive Waste, Specific Safety Requirements

Geological Repository (GR) Safeguards

Proliferation-relevant features

- Strategic value of Pu (U-233, HEU) in Spent Nuclear Fuel (SNF)
- Diversion during **and** after operation („Pu mine“)

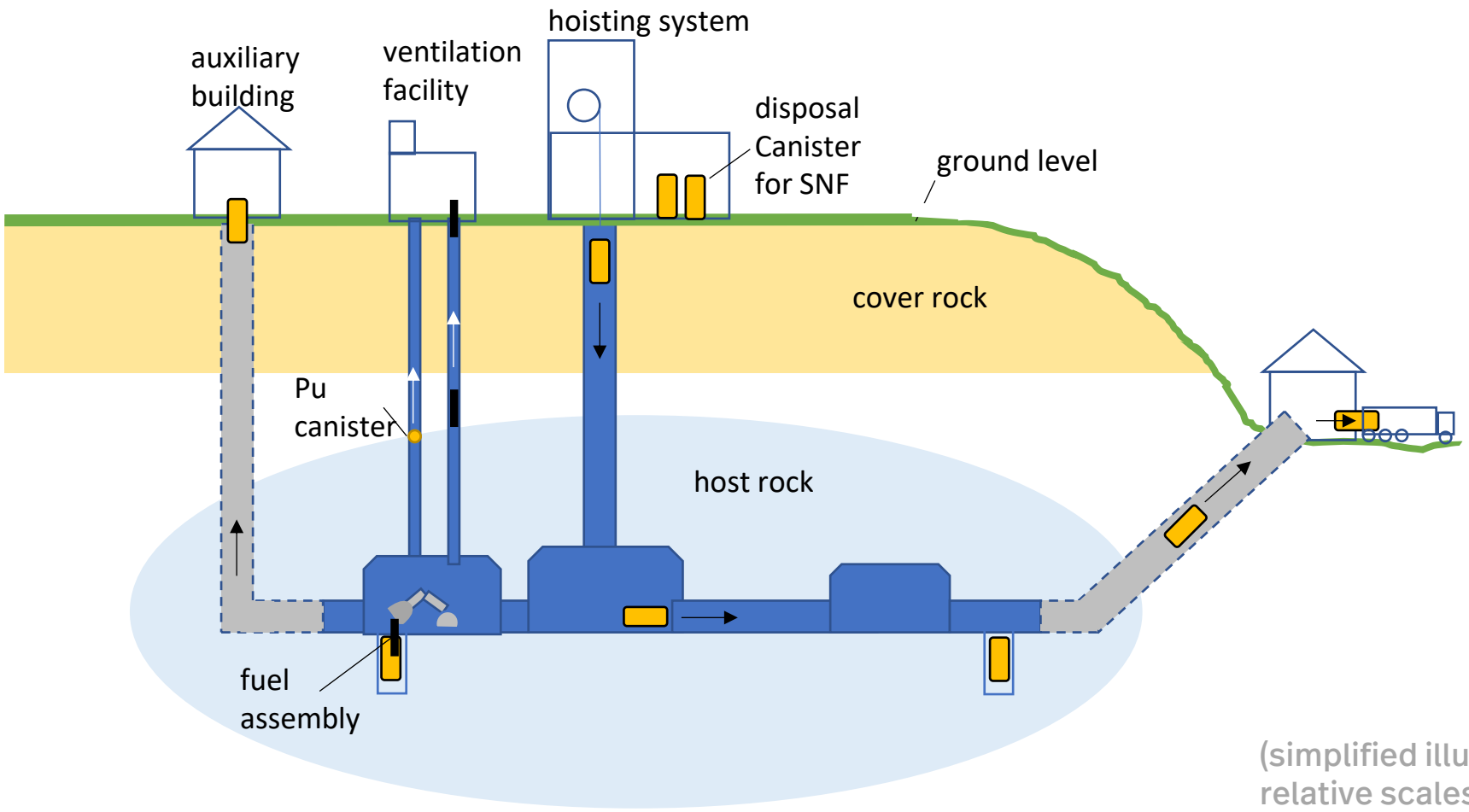
Safeguards-relevant features

- Indefinite emplacement in deep geological formation
- Extended life-cycle of the facility, i.e. from siting to post-closure
- Rock formation as containment
- Operation of underground mine, continuously evolving facility

→Facility-specific concept for safeguards

→Safeguards by Design for Facility & RWM Programme

Diversion Scenarios for a GR



(simplified illustration of a GR, relative scales are distorted)

Safeguards Approach for GR

1. **Design Information Verification**
   - Verify “built-as-declared” on surface and underground
   - Absence of extraction & processing of SNF above/below ground
   - First declaration of baseline before excavation begins
2. **Nuclear Material Accountancy**
   - Verification of SNF before encapsulation - „best-available-method“
   - No termination of safeguards
3. **Continuity of Knowledge**
   - Verify that material flows into repository by monitoring all ways of access to repository (no verification underground)
4. **Detection of Undeclared Activities**
   - i.a., evaluate activities that might compromise integrity

Implementation Challenges

- **DIV underground**
- Continuous throughput
- **Robust verification**
- Operating environment
  - Radiation field
  - Security
  - Mining operations
- **Exclude impact with long-term safety**

Specific Aspects in Germany for the GR

Relevant Documents

- StandAG
- Safety Requirements (EndlSiAnfV, EndlSiUntV)
- National Programme (NaPro)

Specific aspects

- Site Selection
- Retrievability
- Recoverability
- Waste inventory

Result from SafeEnd

Structured requirements

- Traceability
- Adaptability
- Indicates relevant stakeholders and GR phase

Requirements for Geological Repository Safeguards					
No.	Requirement	S	PO	O	PC
DI.1	Design information will be provided during the pre-operational phase on the above-ground area and the geological repository	x	x		
DI.2	Information about the original undisturbed site is to be established with the Agency	x			
DI.3	DIV measures will be performed during the pre-operational and operational phase	x	x	x	
DI.4	DIV is used to verify the absence of capability to remove spent fuel assemblies from a canister	x	x	x	

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Selected Key Findings

1. Site Selection & Exploration

- DIV of underground facility to be conducted prior to operation

→ Early declaration required; current practice is DIV during excavation

→ Alternative approaches required/possible?

2. Retrievability

- Safety Regulation requires technical readiness; reasonable response times
- Cask retrieval is baseline diversion scenario

→ Diversion scenario already considered in SG approach

3. Waste Inventory

- Variety of fuel types + emplacement of non-safeguarded HAW
- Potentially nuclear material emplaced in co-located repository for LAW & MAW

→Monitoring technically challenging

Conclusion & Outlook

Consider evolution of repository design & disposal concept in „Safeguards-by-design“

Research study on Safety & Safeguards
(Call for tender under preparation)

→Methodological approach for a **systematic safety assessment of safeguards methods** based on the safety case

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Thank you.

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