Student Outreach & Internship Programme

EPFL, 12.11.2025

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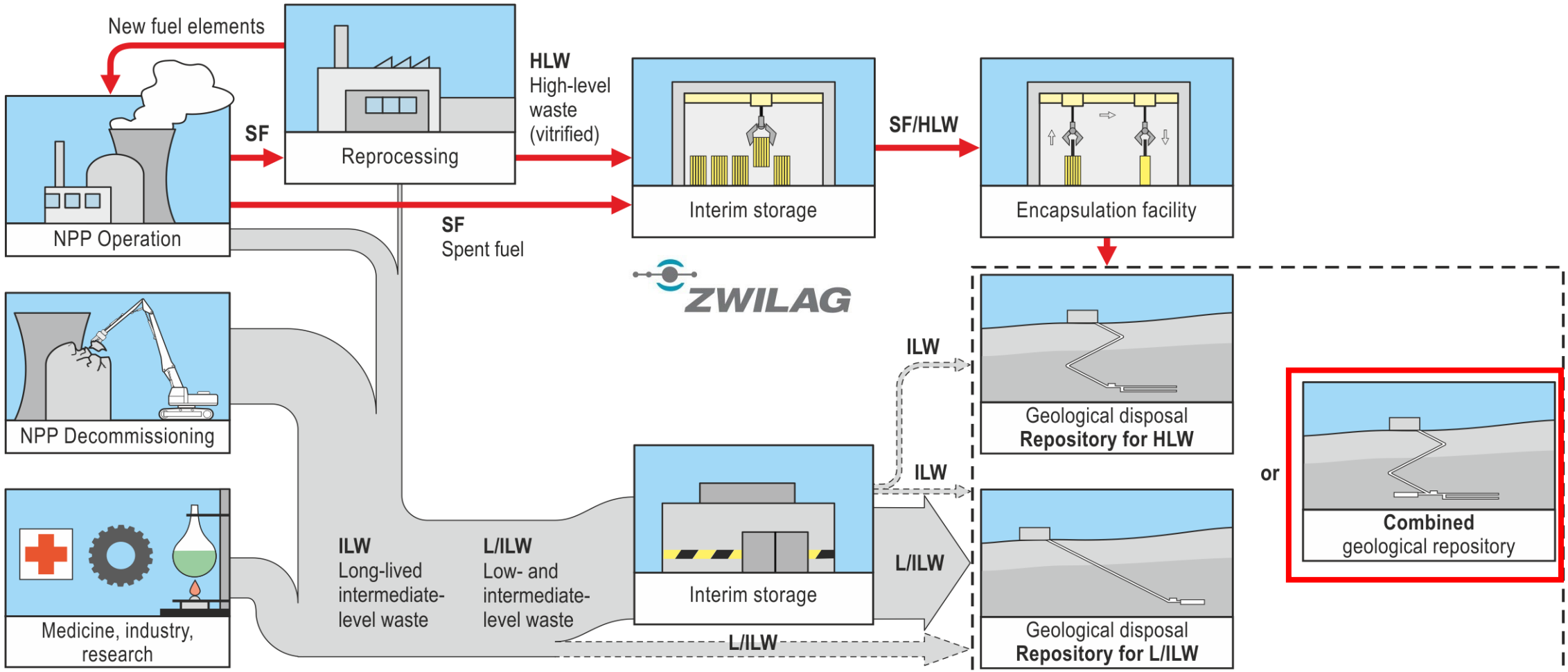
nagra.

Introduction: Who are we?

- We are the **Swiss National Cooperative for the Disposal of Radioactive Waste** ↔ **Nagra**
- Our **mission** is to dispose of radioactive waste, by constructing a deep geological repository for Switzerland.
- Established in 1972 by the **NPP operators and the Swiss government.**
- Around **130 employees**:
  mainly scientists and engineers.
- Financed by the waste producers
  (the “polluter pays” principle):
  - Swiss NPPs: ~92%
  - The Swiss government: ~8%

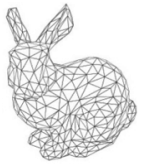
Swiss radioactive waste management concept



Main licensing steps and status

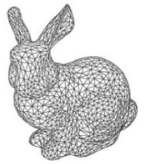
General licenses 2024

- Fixes the sites, etc.



Nuclear **construction license**

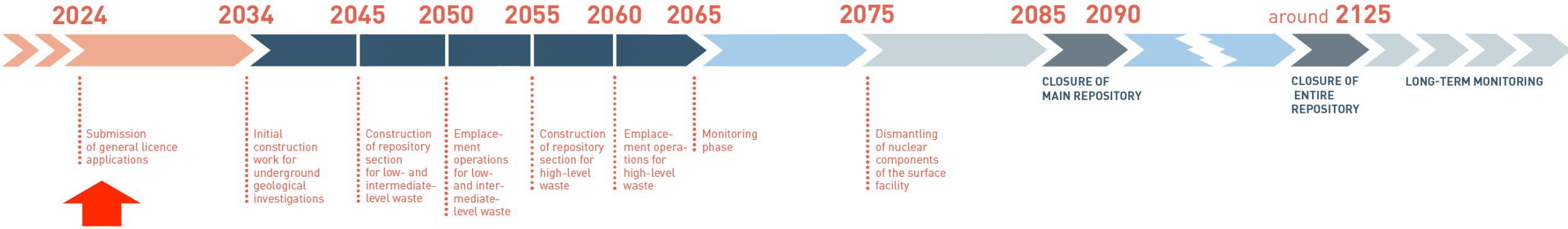
- Fixes constructional aspects, etc.



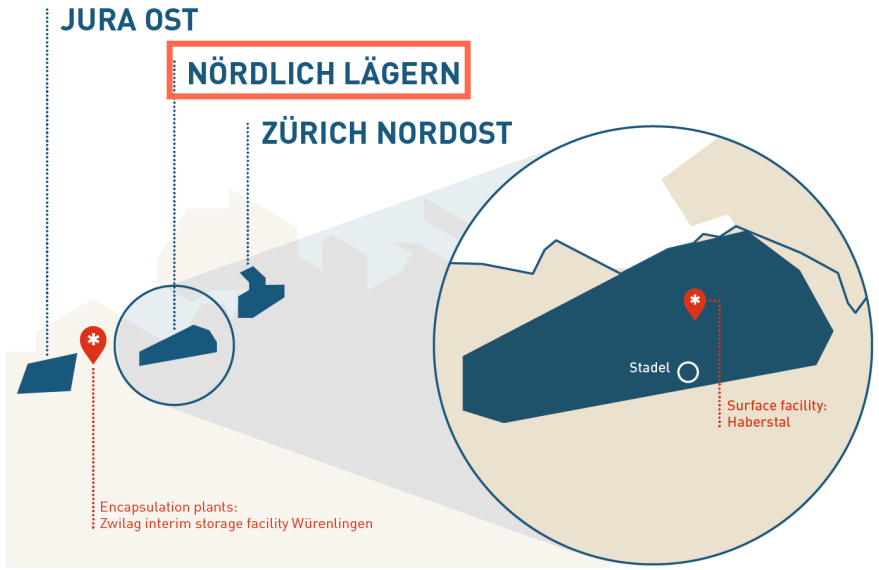
Nuclear **operation license**

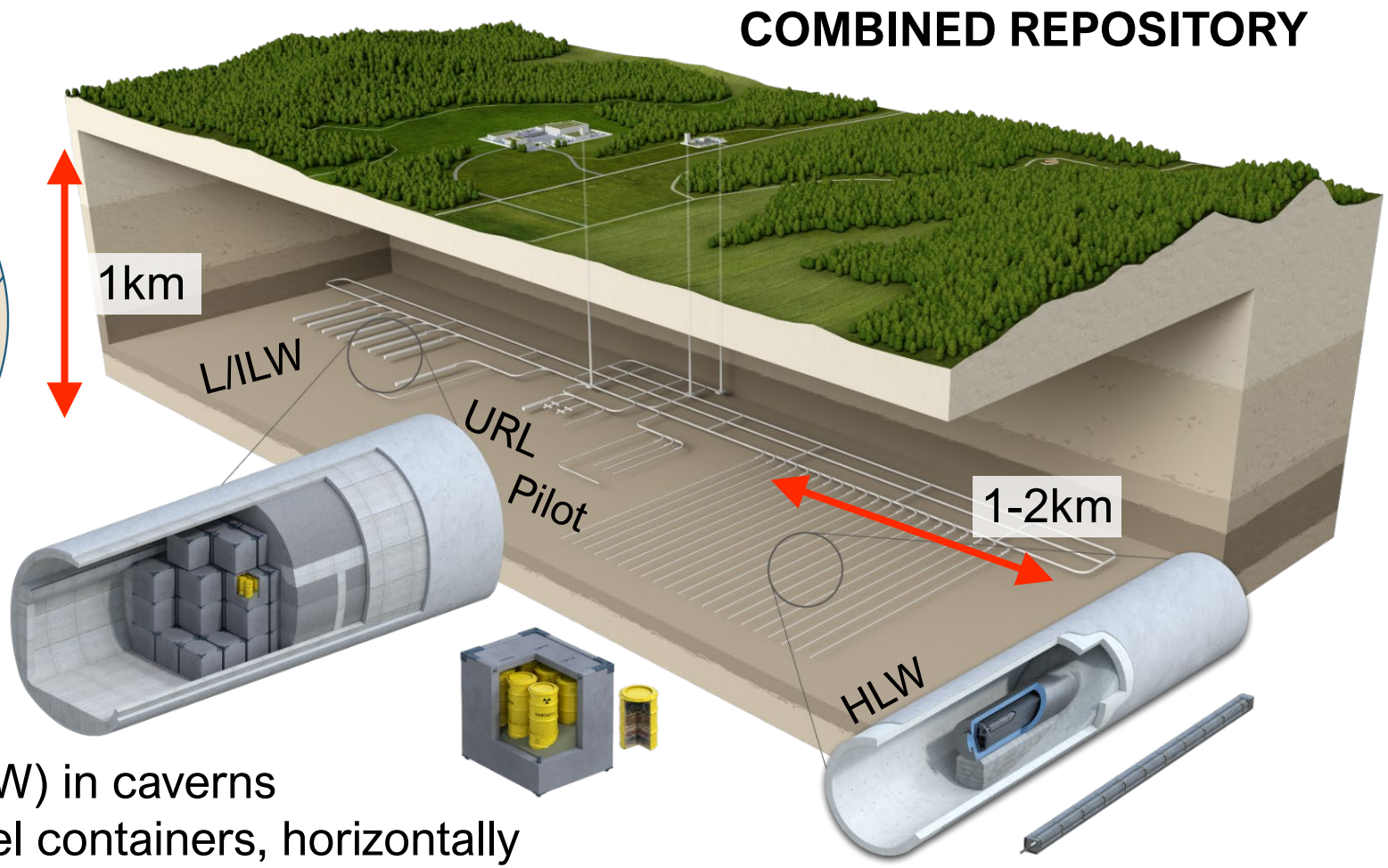
- Fixes operational aspects and the detailed design of the engineered barrier system, etc.

Closure license



Current deep geological repository concept





not to scale

- **Access by shafts**
- **Underground investigations** (URL)
- **Pilot repository**
- Off-site **encapsulation plant**
- **Low & intermediate level waste** (L/ILW) in caverns
- **High level waste** (HLW) in carbon steel containers, horizontally emplaced in tunnels (3m diameter), backfilled with bentonite

INV: -> KNOW YOUR WASTE AND HOW IT BEHAVES!

- What kind of waste do you have? How much? → **Volume**
- How radioactive is it? What is the half-life? Radiotoxicity? → **Activity (t)**
- How much heat does it produce? → **Decay Heat**
- Could it achieve criticality (now or later)? → **Criticality Analyses**
- How is it transported/repackaged over time (nuclides/packages)? → **Safety Analyses / Logistic Optimization**

∴ A lot of characterization and analysis work

+ Support of Waste Producers:

- Shielding Calculations → **Dose Rates**
- Decommissioning Planning → **Segmentation Planning, Packaging Concepts, Dose Rates**

Student outreach & internship programme: Retrospective

- Programme started in 2009 – initiated by Prof. Prasser
- 65+ students from 24 countries completed their internship at Nagra
- 14+ MSc theses and 4(+1) PhD theses

Europe:
Spain
France
Lithuania
Poland
Slowakia
Greece
Czech Republic
Italy
Switzerland
Germamy
Ukraine
Croatia
Serbia
Austria
Cyprus
Estonia
UK

Outside Europe:
China
India
Lebanon
Singapore
Egypt
USA
Mexico

Student outreach

- Student project at Nagra → at the **interface between research & industrial application**
- Nagra interns **actively contribute** to Nagra's RD&D, optimisation, technical and safety assessment work by:
  - Carrying out calculations for **characterising** the Swiss **nuclear waste inventory**
  - **Optimisation** of packaging and repository
  - Implementing **safety case evaluations** of the final disposal concept,
    e.g. criticality safety, etc.
  - Developing **new computational methods**
  - etc.
- **Many thanks to all our interns**:
  your contribution is highly appreciated!

More then 14 MSc.-Theses completed in our group!

Hadjigeorgiou, M. [2022]: Sensitivity Studies on the Structural Response of a PWR Spent Fuel Sub-Assembly using Finite Element Modelling; Master Thesis, EPFL, Lausanne.

Bellotti, M. [2020]: Towards beam modelling for static structural analysis of spent nuclear fuel rods"; EPFL, Lausanne.

Tomic G. [2019]: Validation of the Nagra Advanced Methodology for Activation Characterization for the Leibstadt NPP including Waste Packaging Concept for activated RPV, Internals and Building Structures ; EPFL, Lausanne.

Pisano, P. (2018): Validation of the Nagra Activation Calculation Methodology for the Beznau NPP and Development of an Activated Materials Packaging Concept; EPFL, Lausanne.

Scolaro, A. (2016): Implementation of the Nagra Activation Calculation Methodology for the Gundremmingen Nuclear Power Plant; Master Thesis, EPFL, Lausanne.

Vlassopoulos E. (2015): Development of an Optimization Code for the Logistics of Spent Fuel Assembly Loading into Final Disposal Canisters; Master Thesis; EPFL, Lausanne.

Bykov V. (2014): Enhancement and validation of the NPP Mühleberg MCNP activation simulations for Swiss Decommissioning Planning. Master Thesis. ETH, Zürich.

Yan Y. (2013): An MCNP generic sample activation model for validation of the Nagra NPP activation methodology; Master Thesis; EPFL, Lausanne.

Zvoncek P. (2012): Comparison and suitability analysis of codes for NPP ex-core activation calculations; Master Thesis; ETH, Zürich.

Tamaseviciute E. (2011): Neutron streaming investigation outside the RPV of the Gösgen Nuclear Power Plant with the Monte Carlo Method; Master Thesis; ETH, Zürich.

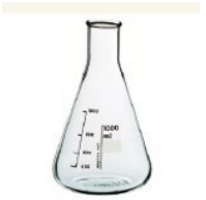
Pantelias Garcés M. (2010): Monte Carlo Simulation for reactor pressure vessel activation analysis; Master Thesis; ETH, Zürich.

Potential project #1:
Radiological characterisation of cemented resins

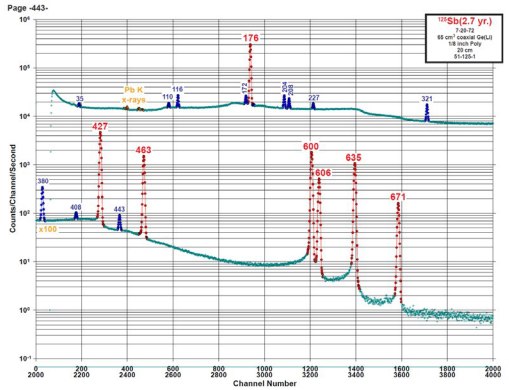
Batch of cemented resins

Dose rate measurement of all drums

Sample from one drum



Gamma spectroscopy to determine activities of set list of N gamma emitters
→ nuclide vector with activity ratios assumed for all drums



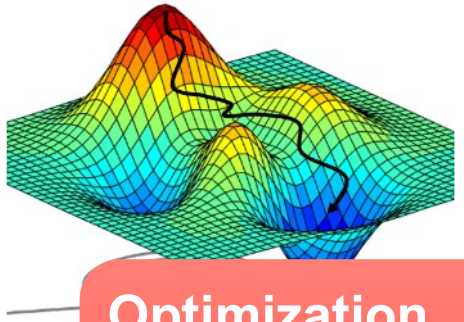
Gamma-Ray Spectrum Catalogue, https://gammaray.inl.gov/SitePages/catalog_ge.aspx

$$DR_{drum} = \sum_{k=1}^{N} DCF_k \cdot A_k = A_n \cdot \sum_{k=1}^{N} DCF_k \cdot \frac{A_k}{A_n}$$

Conversion factor activity-to-dose for nuclide k. needs to be modeled and is dependent on drum and DR measurement geometry

Potential project #2:
Comparison of decay heat calculations with multiple codes

Input data
- SNF/TLB database
- Decay heat calculations
- BEVA characteristics



Optimization algorithm
- Minimize # of ELBs

Results
- # of ELBs
- Detailed loading plan
- More…

- We employ a complex optimization strategy to plan the logistics of SNF disposal
- Design constraint: max. decay heat in disposal canister

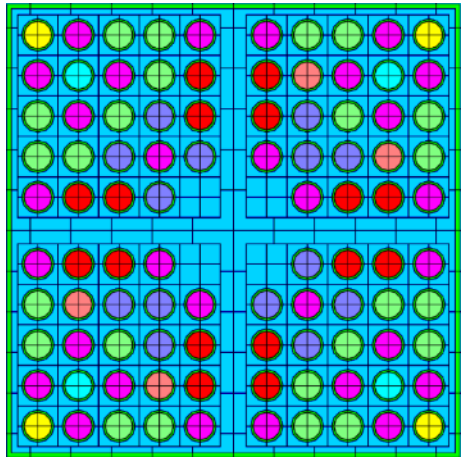
→ Understanding the uncertainty in decay heat calculations is crucial.

→ **Comparison and verification with multiple codes!**

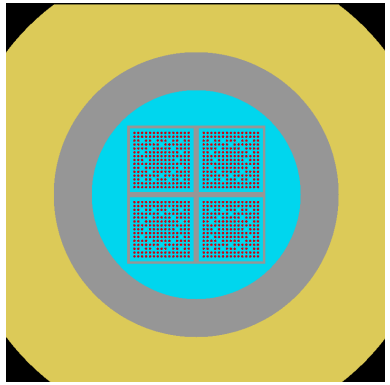
Potential project #3:
Exploration of thermal and mechanical effects of canister filling

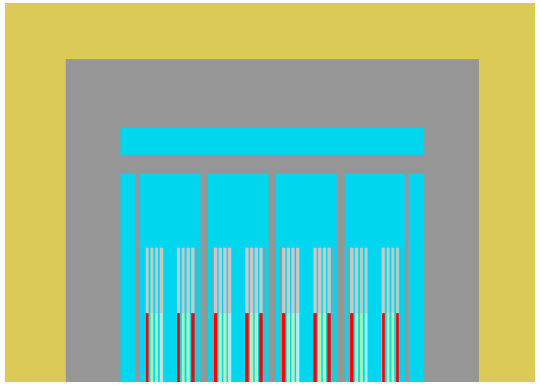
- What you could be working on:

  - Setting up computational models for various configurations of the final disposal canister
    (with different fuel assembly types, materials, etc.)
  - Calculating keff, for different canister configurations using Monte Carlo code like SCALE, MCNP, etc.
  - Calculating T profile for different types of filling
  - Modeling mechanical behavior in postulated scenarios with and without filling material



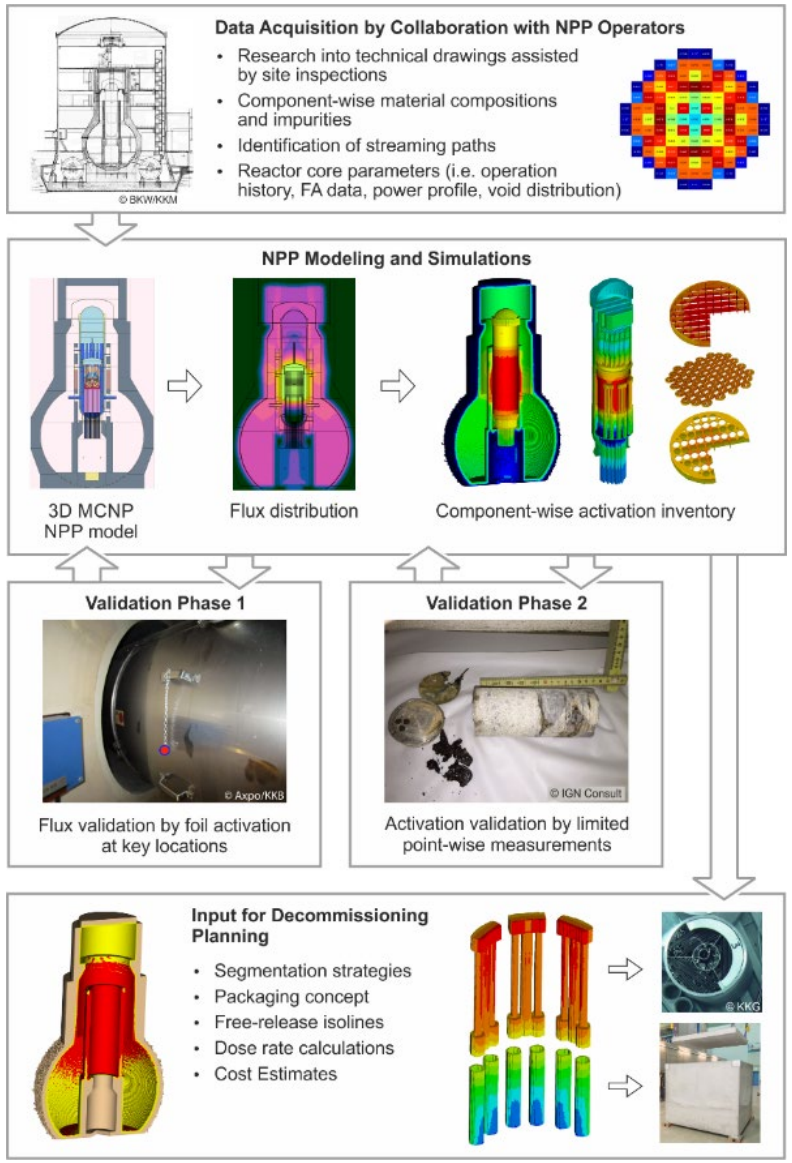
KENO-VI models of a BWR fuel assembly (above) and PWR final disposal canisters





Potential project #4:
Further development and application of AMAC

- Background: activation characterization of Swiss NPPs for decommissioning planning and cost estimations
  - AMAC is the (Advanced Methodology for Activation Characterization)
  - First step: calculate neutron flux with MCNP
    - Assumption: “representative state” of the core
  - Second step: activation calculation using this neutron flux for the entire operational history
  - Also, further refinement of the NPP models and support of NPP planning and decommissioning operations.



What an internship at Nagra looks like

- Typical duration: 3 months (e.g. July – September)
  However, different time frames may also be possible – depending on availability of topics & time resources.
- Typical workload: 100% full time — i.e. 8.5 h/day x 5 days/week
  Other preferences may be accommodated.
- **Internship is paid**
- Nagra takes care of the work permit application
- MSc Thesis projects may be possible – discussion during the internship
- Each intern gets assigned a technical coordinator
- Wherever feasible **Nagra interns are encouraged to**:
  - Publish scientific papers & participate in industry events and conferences
  - Get involved in experimental activities

HAA-ELB design optimisation experiments in Mellingen

WATCH THIS SPACE!

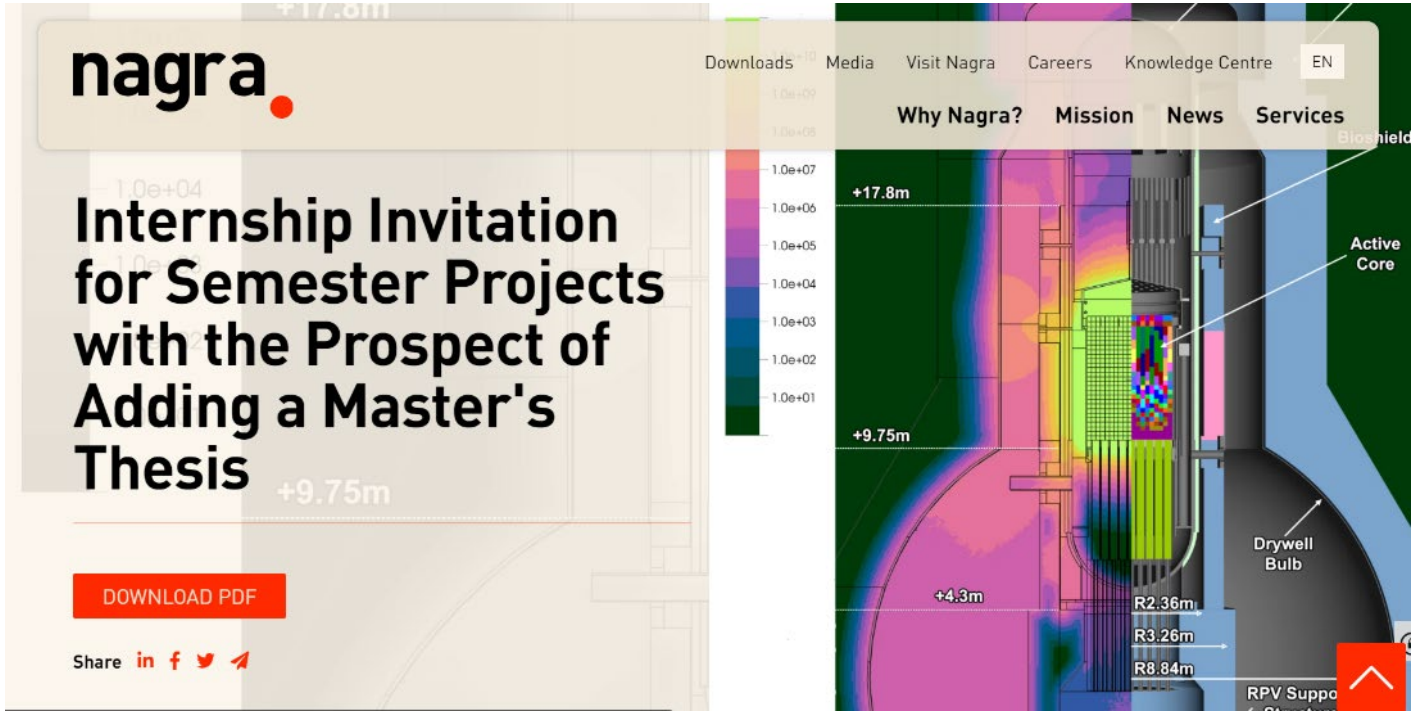
All internship projects available on our homepage.

Application documents:

- Cover letter
- Transctipt of records (BSc, MSc)
- CV

Projects will be available online around mid-Jan. 2026.

Interviews will take place in Feb. 2026.



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thank you
for your attention

nagra.