The use of Underground Research Facilities in the development of deep geological disposal

Radioactive Waste: Meeting the Challenge
Science and Technology for Safe and Sustainable Solutions
23-24 September 2014 in Vienna

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International Atomic Energy Agency Scientific Forum
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What is a URL?

An underground facility:

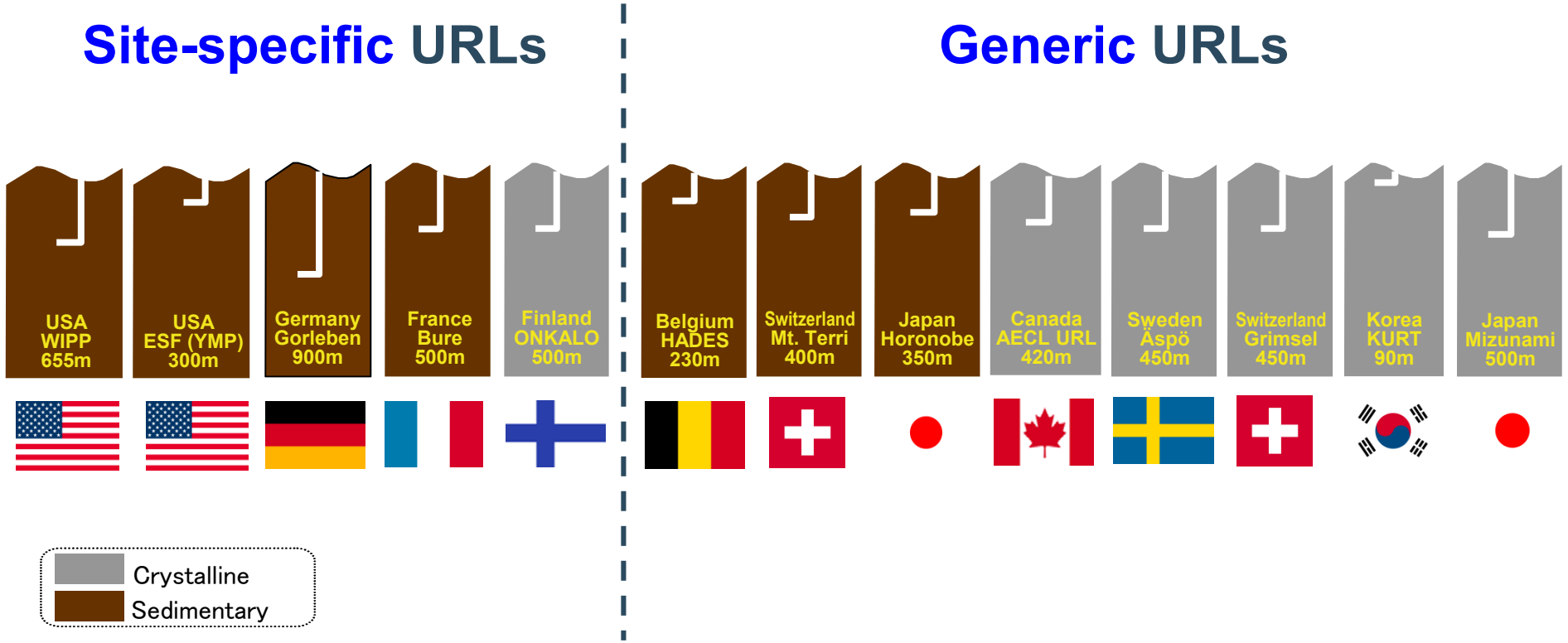
- for acquiring expertise to develop a nuclear waste repository
- located in geological environments that are suitable for repository implementation or that offer realistic representations of those environments
- constructed at depth of a few hundred meters or may be closer to the surface
- provide for a concrete illustration of what a geological repository may look like and contribute to confidence building also by the general public

Type of URLs

- **Generic** URLs:
  - ✓ no waste will ever be disposed of and only typical research and development activities will be performed

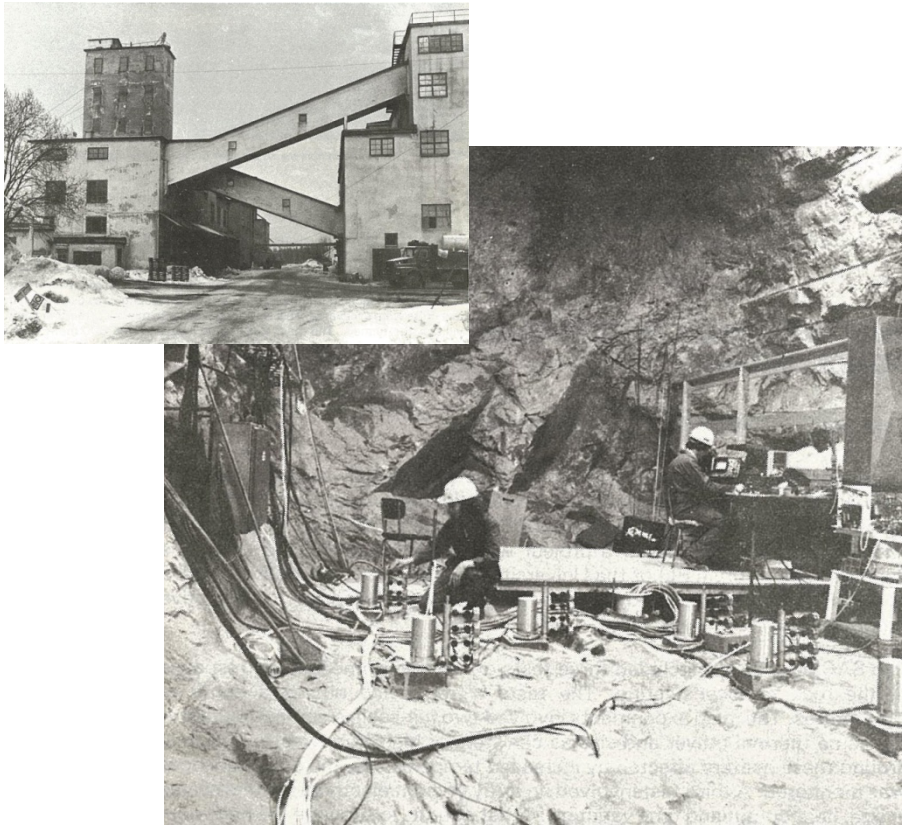
- **Site-specific** URLs:
  - ✓ similar activities are undertaken as those in generic URLs, but can go further and examine actual properties of the site and demonstrate feasibility of construction technology, waste emplacement etc

Major URLs: type, host rock, depth



Based on Underground Research Laboratories (URLs), OECD/NEA, 2013

Early generic URLs: in pre-existing mine



- crystalline rock -

Stripa mine (Sweden)

(1976-1992)

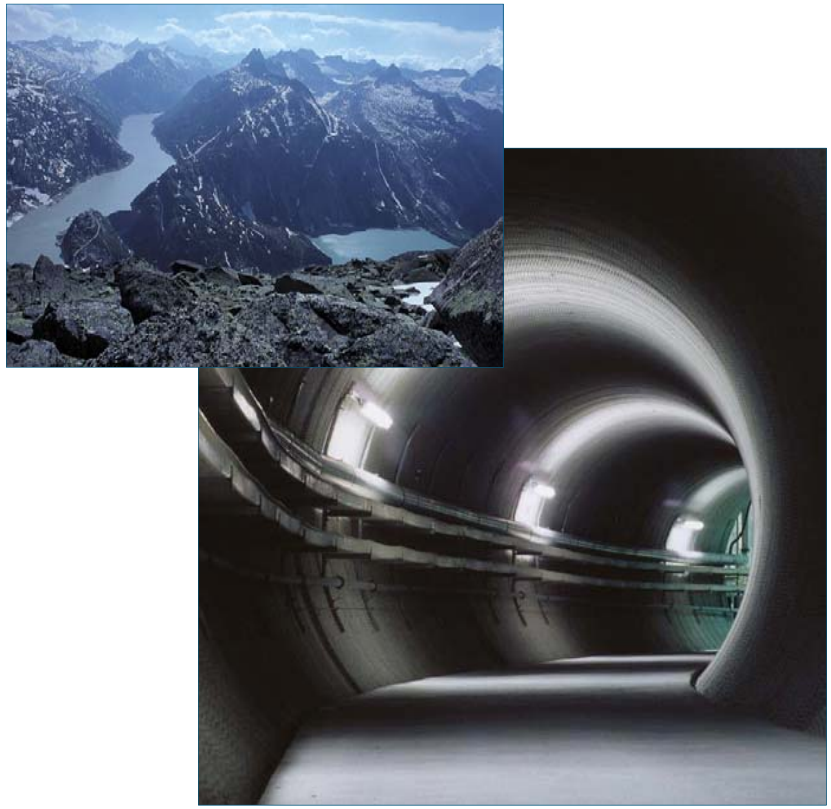
from *THE INTERNATIONAL STRIPA PROJECT, EXPERIMENTAL RESEARCH ON THE UNDERGROUND DISPOSAL OF RADIOACTIVE WASTE*, Background and Research Results, SKBF and NEA, March 1983

- sedimentary rock -

Tono mine (Japan)

(1986-2004)

Generic URLs: near tunnel



- crystalline rock -

Grimsel (Switzerland)

(1984-)

Courtesy of Nagra

- sedimentary rock -

Mt. Terri (Switzerland)

(1995-)

Courtesy of Nagra

Generic URLs: purpose-built at depth

- crystalline rock -

AECL-URL (Canada)

(1984-2006)

- sedimentary rock -

Horonobe (Japan)

(2010-)

Site-specific URLs:

- crystalline rock -

ONKALO (Finland)

from http://www.posiva.fi/files/1587/447/onkalo13_web.jpg

- sedimentary rock -

WIPP (USA)

(operation: 1982-) (repository:1999-)

from http://www.wipp.energy.gov/science/graphics/wastedrums.jpg

What purpose does URL serve? : Example1

- **Developing technology and methodology**

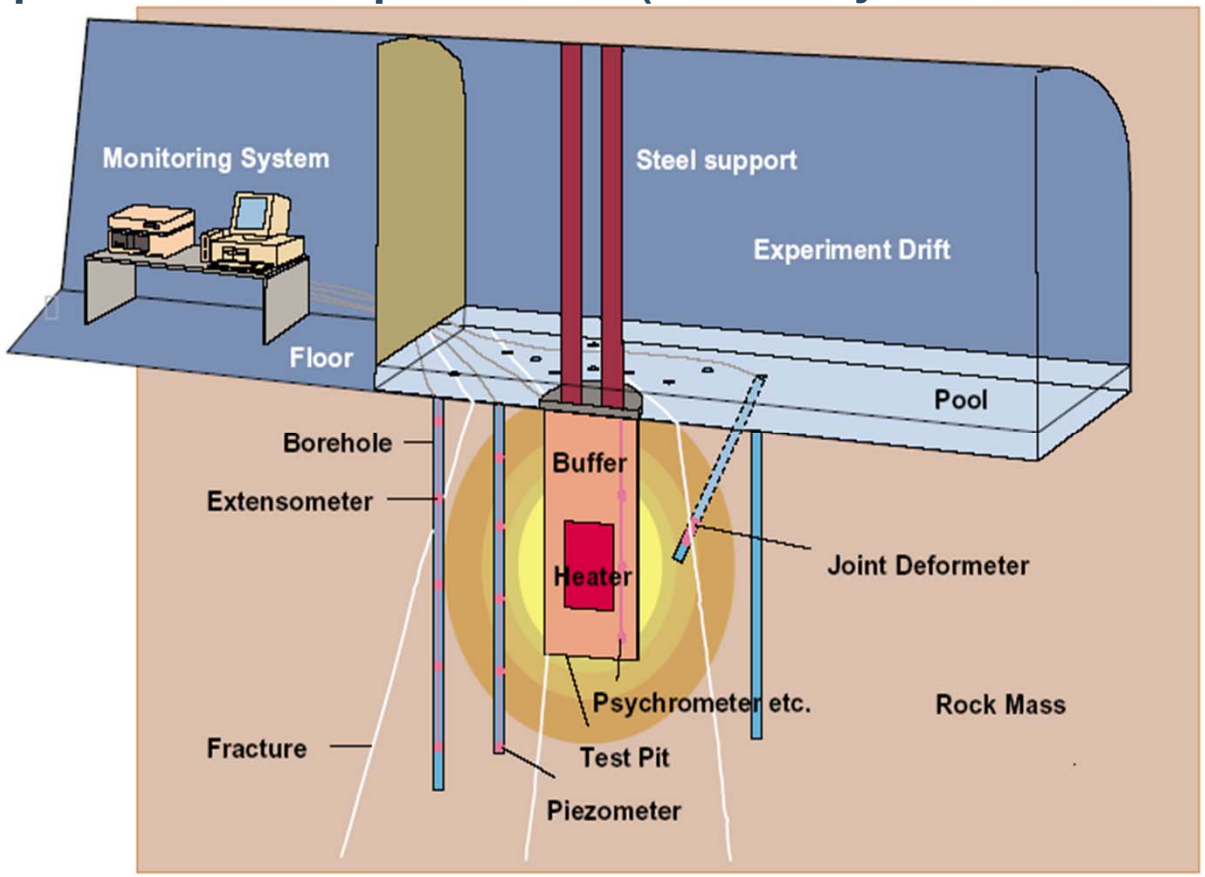
Example: Development of low alkaline cement

Shotcreting test at Horonobe URL

What purpose does URL serve? : Example2

- **Providing data to understand the behavior**

Example: Experiment of coupled THMC (Thermo-Hydro-Mechanical-Chemical) process

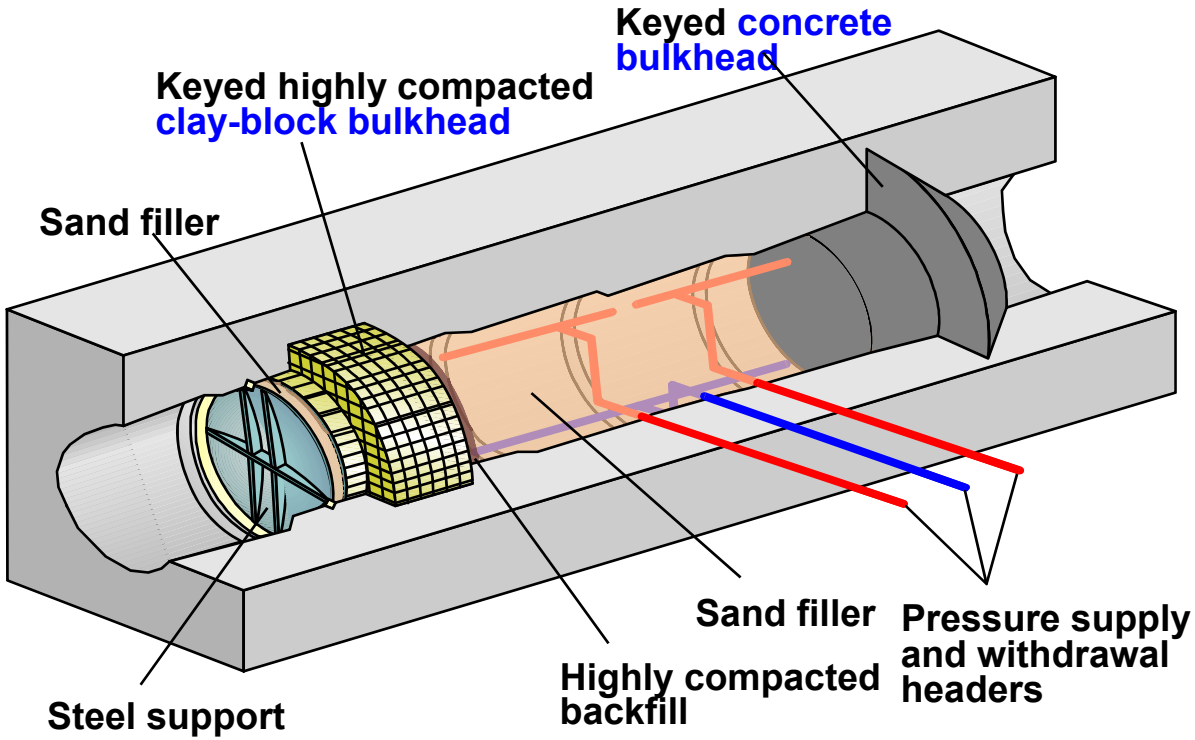


In-situ heater experiment

What purpose does URL serve? : Example3

Demonstration of the robustness of the design

Example: Sealing experiment



The Tunnel Sealing Experiment: A full-scale *in situ* demonstration of the technologies for construction of one concrete and one bentonite-based tunnel seal (at AECL-URL)

What purpose does URL serve? : Example4

Training personnel for safe operation

IAEA Technical Cooperation Project RER/9/103 – Training Course: Fundamentals of Geological Disposal 11 –15 Nov. 2013, Mizunami URL, Japan

Building confidence with stakeholders

Underground technical tour for younger students（future stakeholders) at summer science camp, Horonobe URL, Japan

Expensive but valuable

- Construction and operation of URL is time-consuming and expensive
- Because it requires:
  - ✓ special excavation techniques to minimize damage to the rock to achieve high laboratory standard
  - ✓ vast amount of underground work

⇒ Despite their high costs, the fact that URLs are so widely implemented in the world is an indication of their value to national disposal programs

- ✓ This makes international co-operation in underground studies advantageous

Summary and a way forward

- URLs provide important technical knowledge and increase confidence in developing repository program

- Types and amounts of work in URLs have evolved with time
  - ✓ Early stage: old mine URL; basic testing focusing on key processes
  - ✓ Today: purpose-built URL; large-scale, realistic, integrated (and complex) experiments

- Construction and operation of URL is taking long time and high costs
  - ✓ International cooperation with a URL organization is effective in terms of sharing not only costs but also existing knowledge and expertise
    - ➢ IAEA URF network offers a good arena for making such a collaborative project