
**REMARKS ON THE
US-DOE AND ON THE GERMAN REPOSITORY PROGRAMS
-
LESSONS LEARNT**

- I. The German Repository Program**
- II. Similarities and Differences of the US and German Programs**
- III. Special Case: Asse Experimental Repository**
- IV. Lessons Learnt**

I. The German Repository Program

- **The first nuclear program (1958 – 1962) pointed out the importance of radioactive waste disposal**
- **It was inspired by the US-NAS Publication 519 (1957), suggesting salt as repository host formation**
 - ➔ *All radioactive waste was to be disposed of in Deep Geological Repositories*
 - ➔ *Heat generating waste was to be disposed of in a salt formation*

A first experimental DGR (Asse) starts receiving LLW on April 4, 1967

In the early 70' Germany develops a concept for an Integrated Waste Management Center (NEZ):

- **A SF reprocessing plant co-located with**
- **A HLW and LILW repository**

A site for the NEZ (Gorleben) is selected in 1977

With the 4th amendment to the ATG (1976) the *Federal Government becomes responsible for providing waste repositories*

The new ATG requires a *Plan Approval Procedure* for repository licensing

→ *Waste disposal at Asse discontinued in 1978*

Thereafter only use as URL and preparation for closure

Konrad mine investigated as LILW repository

1979 – 1983 surface site exploration at Gorleben

1985 – 1986 start of exploration mine development

Gorleben - Milestones

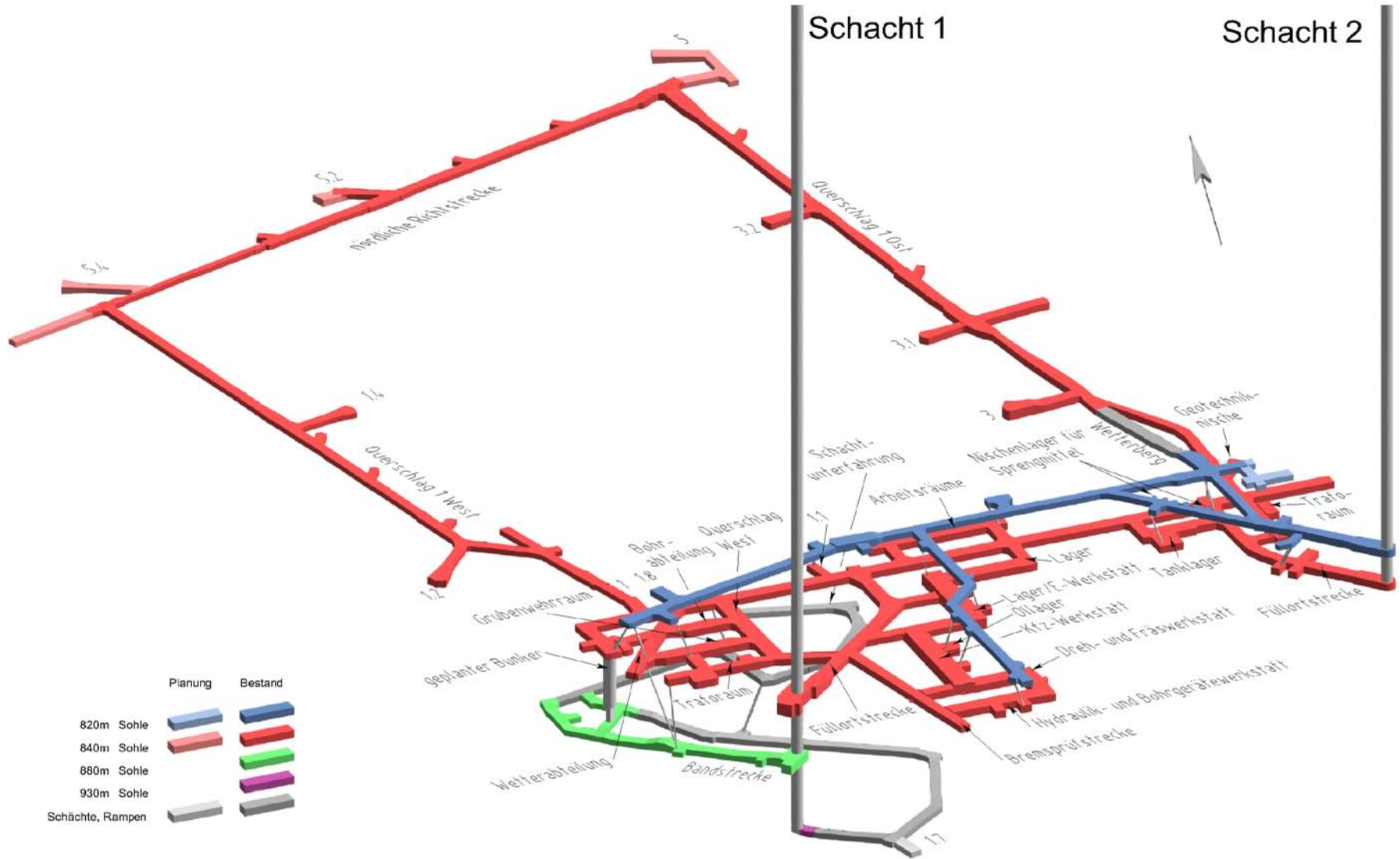


- 22.02.1977 Site designation Gorleben (Nukleares Entsorgungszentrum/NEZ)
- April 1979 Start of surface site characterization
- 1980/1981 Four deep boreholes (1002 / 1003 / 1004 / 1005)
- Mai 1983 Comprehensive suitability statement (PTB)
- Sept. 1986 Ground-breaking for Shaft 1
- Oct. 1996 Communication between Shaft Gorleben 1 and Gorleben 2 (840-m-Sohle) established: Thereafter excavation of infrastructure area and characterization of Exploration Area 1
- 01.10.2000 Site characterization interrupted. Thereafter stand-by operation only
- 03.03.2010 Germany announces to the IAEA Board of Governors that site exploration will continue
- 01.10.2010 Politically motivated Moratorium to the exploration of the Gorleben site ends

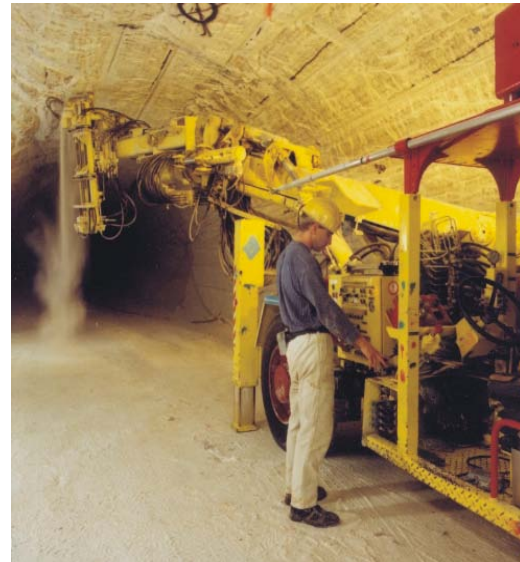
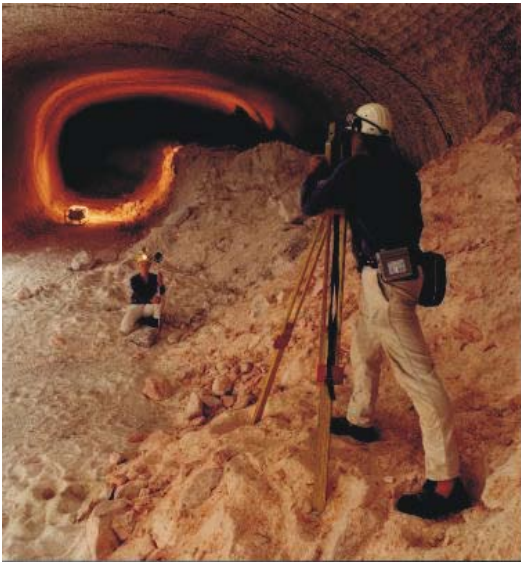
Gorleben Site



Gorleben Site Exploration Mine



Gorleben Site Exploration Mine



Concurrently with site development, the technology for waste disposal was developed and demonstrated

- **A pilot conditioning plant was designed and built**
- **Two interim storage facilities for ~ 4000 THM were commissioned**
- **The technology for SF and HLW shaft hoisting to the disposal level was developed and demonstrated**
- **The full underground waste handling and disposal system was developed and tested**
- **In recent times an optimized alternative for HLW and SF borehole disposal was demonstrated**

Repository Technology Development – Conditioning Plant



Repository Technology Development – Waste Disposal



Repository Technology Development – Waste Disposal

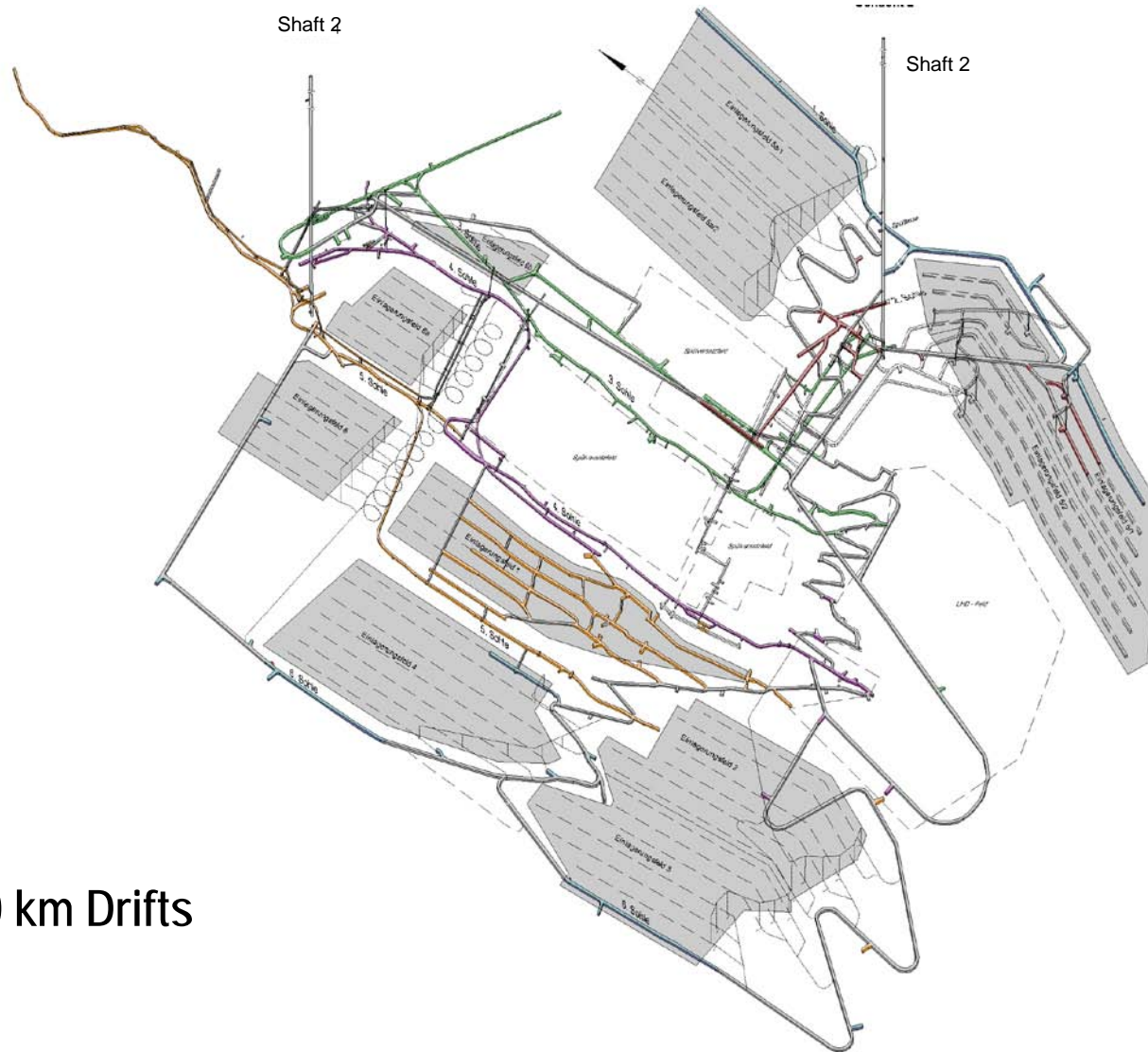


Konrad Repository Milestones



1965 – 1976	Iron ore production approx. 7 mil. t; Deposit: ~ 1.4 billion t
1975	Preliminary survey as candidate site
1982	Site Suitability statement and License Application submitted
09/92 - 03/93	Public hearing (75 hearing days)
14.06.00 / 17.07.01	Consensus Agreement - <i>Finishing licensing procedure</i> - <i>Withdrawal immediate enforcement</i>
01.08.01	Radiation Protection Ordinance amendment License application amendment
05.06.02	LICENSE GRANTED
2002-2008	Litigation
2008-2010	Start of Repository Construction
2013/2014	First Planned DISPOSAL START
2019	Currently Likely Disposal Start

Konrad Repository – Under Construction

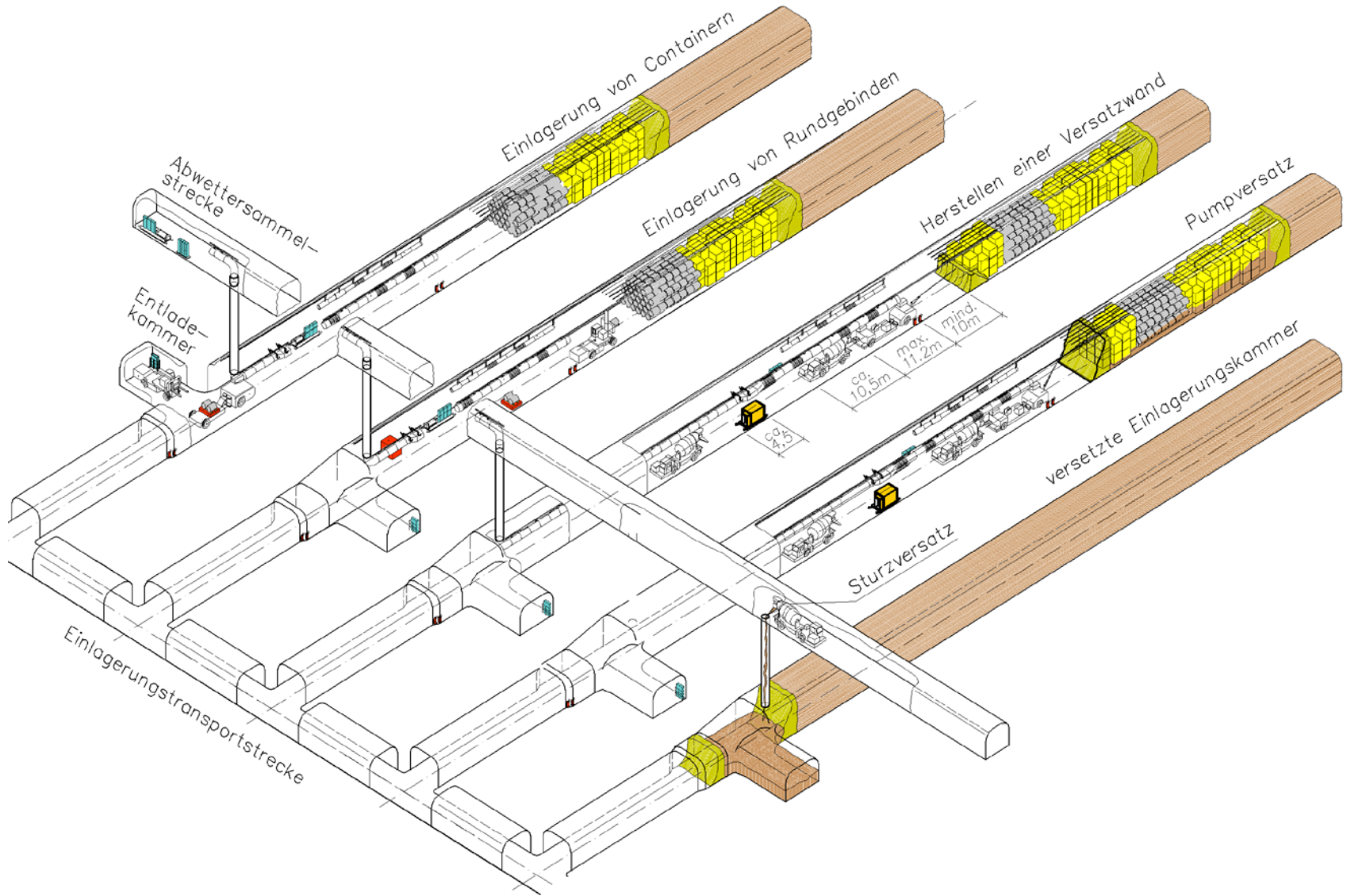


- 40 km Drifts

== Konrad Repository – Under Construction ==



Konrad Disposal Scheme



== Morsleben – Repository Milestones ==



- 1970 Bartensleben mine selected as repository
- 1971 Start of trial disposal (LLW)
- 1974 Approval of repository construction
- 1981 / 1986 1st and 2nd permanent operation licenses
- 10 / 1990 Morsleben repository a Federal Facility under BfS, operated by DBE
- 1991 Disposal stop, refurbishment
- 1994 Disposal restarted
- 09 / 1998 Waste acceptance interrupted
- 05 / 1999 Waste disposal terminated
Licensing procedure only for closure
- 11 / 2000 Advanced backfilling - repository closure to follow
- 2011 Public hearing?
- 2012... License for closure?

Morsleben Repository



II. Similarities and Differences of the US and German Programs

USA legal basis: NWPA which

- *Assigns provision of repositories to the US Government (DOE-OCRWM)*
- *Construction and operation contracted to an M&O, for 5 years (extendable)*
- *Fixed steps of the realization process*

German legal basis: ATG, which:

- *Assigns provision of repositories to the German government (BfS under BMU)*
- *Defines a “third party” who actually construct and operates the repositories (DBE, purpose-founded by government, mixed ownership)*
- *Fixed a single stop license for all the repository lifetime (Planfeststellung)*

USA: NRC, an independent body, not part of the executive

- *Evaluates the License Application along the lines of protection objectives set up by EPA*
- *Discharge its duties following a time schedule defined by Congress*

Germany: the licensing authority of the Federal State that hosts the repository

- *A different one for the Morsleben Repository (S-A) and for Konrad (in future perhaps Gorleben) (NS)*
- *But acting on behalf of the Federal Government, who supervises the licensing process (BMU)*
- *No independent definition of protection objectives*
- *No fixed time schedule*

USA: Dedicated Fund, account in the Treasury

- *Fed by payments by the utilities/consumers as fraction of a cent per kWh*
- *Budget of the repository program annually appropriated by Congress (political process)*
- *Expenditures increase the federal deficit*

Germany: Provisioning by the waste producers

- *Repository expenditures pre-financed by BMU (with 5 years forecast, 2 years detailed planning)*
- *Outlays annually reimbursed by waste producers (negotiated apportioning, no net impact on deficit)*
- *Morsleben and Asse decommissioning and closure paid from the federal budget (legacy of German reunification or of previous research)*

USA: LA Covers transportation, interim storage (aging), packaging, and disposal

- *Focus on repository long-term safety*
- *Very comprehensive on safety aspects*
- *Limited focus on technology and actual implementation*

Germany: LA Covers only final disposal

- *Transportation, interim storage (aging) and waste conditioning: responsibility of the waste producers*
- *License application covers all aspects and phases of the repository life*
- *Must be based on state-of-the-art BAT*
- *Appropriate technology demonstration therefore indispensable*

USA: Apparently relying on an **extensive technical barrier system**

- *Rationale behind repository concept evolution difficult to understand*
- *Retrievability considerations imposing great constraints on safety concept and implementation*
- *Different protection objectives for 10,000 and one million years ?*

Germany: Mainly relying on the **geological barrier**

- *Site exploration and repository design aim at preserving the geological barrier integrity*
- *SA focus on demonstrating barrier and drift/shaft seals integrity to attain **zero release** repository*
- *Repository concept fully demonstrated and stable*
- *Retrievability ?*

III. Special Case: Asse Experimental Repository

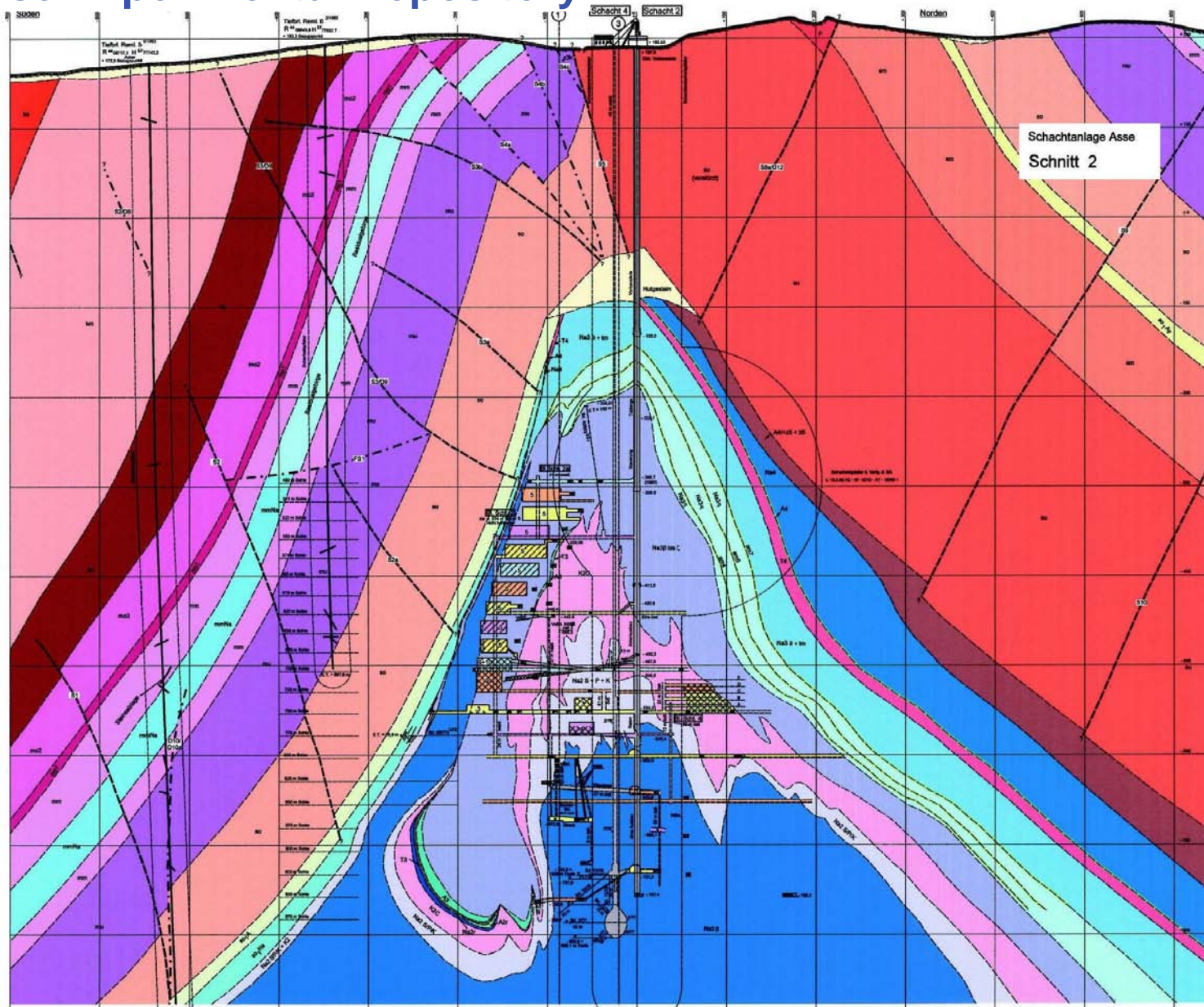
Asse Experimental Repository



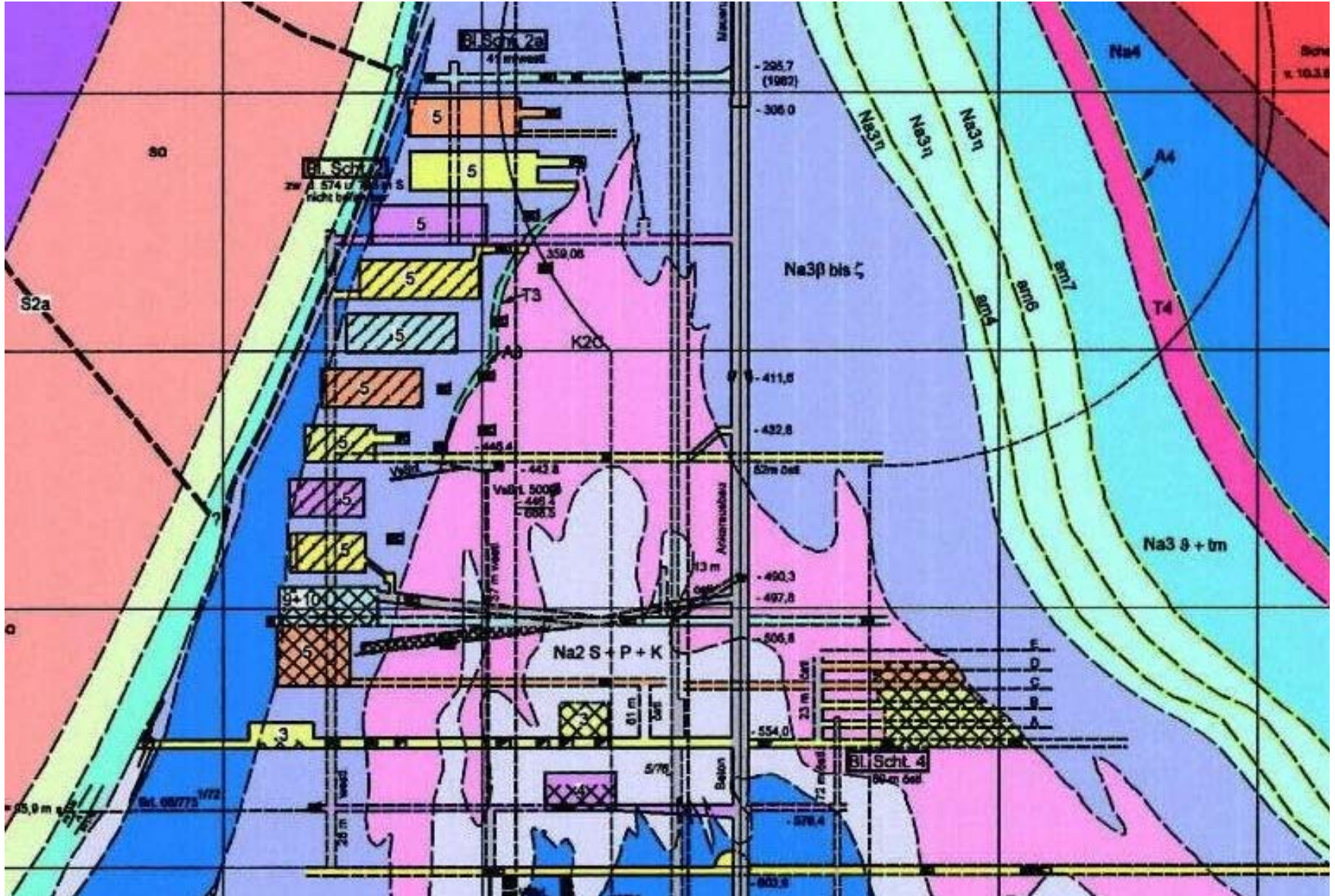
Asse Experimental Repository



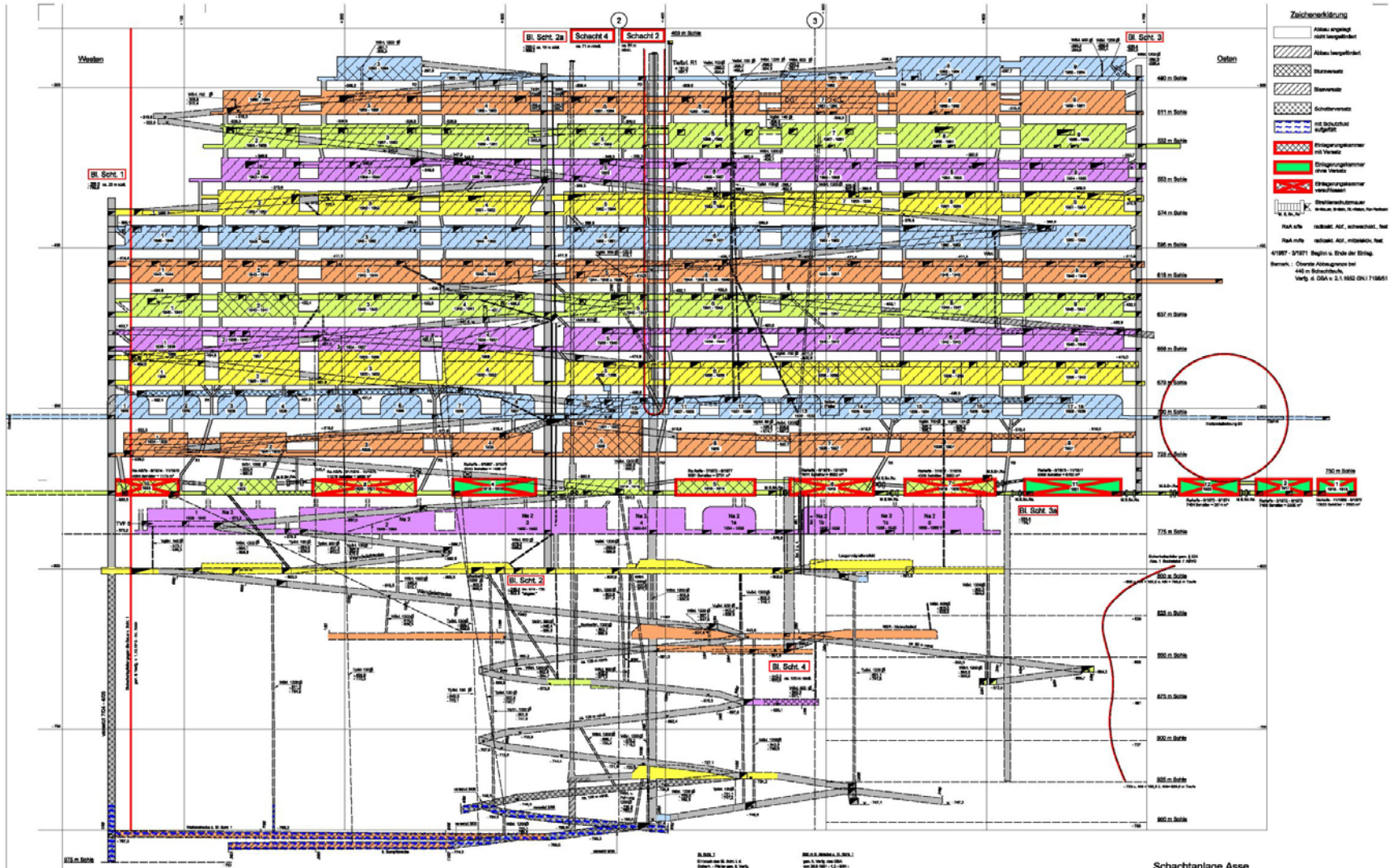
Asse Experimental Repository



Asse Experimental Repository



Asse Experimental Repository



Schachanlage Asse
Seigerriß u. Längsschnitt ①

1:2000

In 2009 the responsibility for the former Asse Experimental Repository was transferred

- ***from the Ministry of Education and Research***
 - ***to the Ministry of the Environment (BMU)***
-
- ***For final closure of the Asse a licensing procedure under the ATG will be conducted***
 - ***Three different closure options were studied by a pluralistic specialist group***
 - ***BfS opted for retrieval of all the waste, as demanded by local stakeholders***
 - ***Currently studies are being carried out to determine whether waste retrieval is really feasible***
 - ***Contingency planning continuing in parallel***

IV. Lessons Learnt

Eliminate Show-Stoppers

- ***Create a consistent organization scheme with appropriate division of responsibilities, involving regulators, implementer, waste producer (IAEA!)***
- ***Implement a sustainable financing system that ensures appropriate availability of funds as required***
- ***Reach multi-partisan agreement on program and its implementation (take it out of daily politics, involve all stakeholders)***
- ***Keep the repository program out of the discussion on new NPPs or lifetime extension***
- ***Necessary “concessions” on siting/design shall not be at the expense of operational/long – term safety***

Improve overall efficiency

- ***Ensure long-term continuity of program and of its management/implementation (permanent M&O ?)***
- ***Implement incentive systems that control costs while promoting innovation, increasing effectiveness of resource use and enhancing repository safety***
- ***Look across the US border: there are others out there, dealing with the same issues***
- ***Fight back the “not invented here” attitude and enhance international cooperation***

== We already started doing it! ==

