REMARKS ON THE
US-DOE AND ON THE GERMAN REPOSITORY PROGRAMS
- LESSONS LEARNT
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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.
German Repository Program

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
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

Schacht 1

Schacht 2

Planung | Bestand
---|---
820 m Sohle
840 m Sohle
860 m Sohle
920 m Sohle
Schächte, Rampen
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
### Konrad Repository Milestones

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

- 40 km Drifts
Konrad Repository – Under Construction
Konrad Disposal Scheme
### Morsleben – Repository Milestones

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1970</td>
<td>Bartensleben mine selected as repository</td>
</tr>
<tr>
<td>1971</td>
<td>Start of trial disposal (LLW)</td>
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<tr>
<td>1974</td>
<td>Approval of repository construction</td>
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<tr>
<td>1981 / 1986</td>
<td>1st and 2nd permanent operation licenses</td>
</tr>
<tr>
<td>10 / 1990</td>
<td>Morsleben repository a Federal Facility under BfS, operated by DBE</td>
</tr>
<tr>
<td>1991</td>
<td>Disposal stop, refurbishment</td>
</tr>
<tr>
<td>1994</td>
<td>Disposal restarted</td>
</tr>
<tr>
<td>09 / 1998</td>
<td>Waste acceptance interrupted</td>
</tr>
<tr>
<td>05 / 1999</td>
<td>Waste disposal terminated</td>
</tr>
<tr>
<td>11 / 2000</td>
<td>Licensing procedure only for closure</td>
</tr>
<tr>
<td>2011</td>
<td>Public hearing?</td>
</tr>
<tr>
<td>2012...</td>
<td>License for closure?</td>
</tr>
</tbody>
</table>
II. Similarities and Differences of the US and German Programs
General Organization

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)
Repository Licensing

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*
Repository Funding

**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)*
Repository License Application

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
Repository Safety Concept

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
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
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!