WISMUT

# A FEDARAL COMPANY IN GERMANY

## Uranium Mining and Milling Environmental Liabilities Management in Germany – Lessons Learned During Almost two Decades of Implementation of the WISMUT Rehabilitation Project

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Presentation at URAM2009, IAEA, Vienna, June 22 – 26, 2009

# WISMUT Rehabilitation Project - Historical background

1946 The Soviet occupation forces in Germany established the state-run company SAG WISMUT with the sole aim to exploit the East German uranium deposits for the Soviet nuclear program.

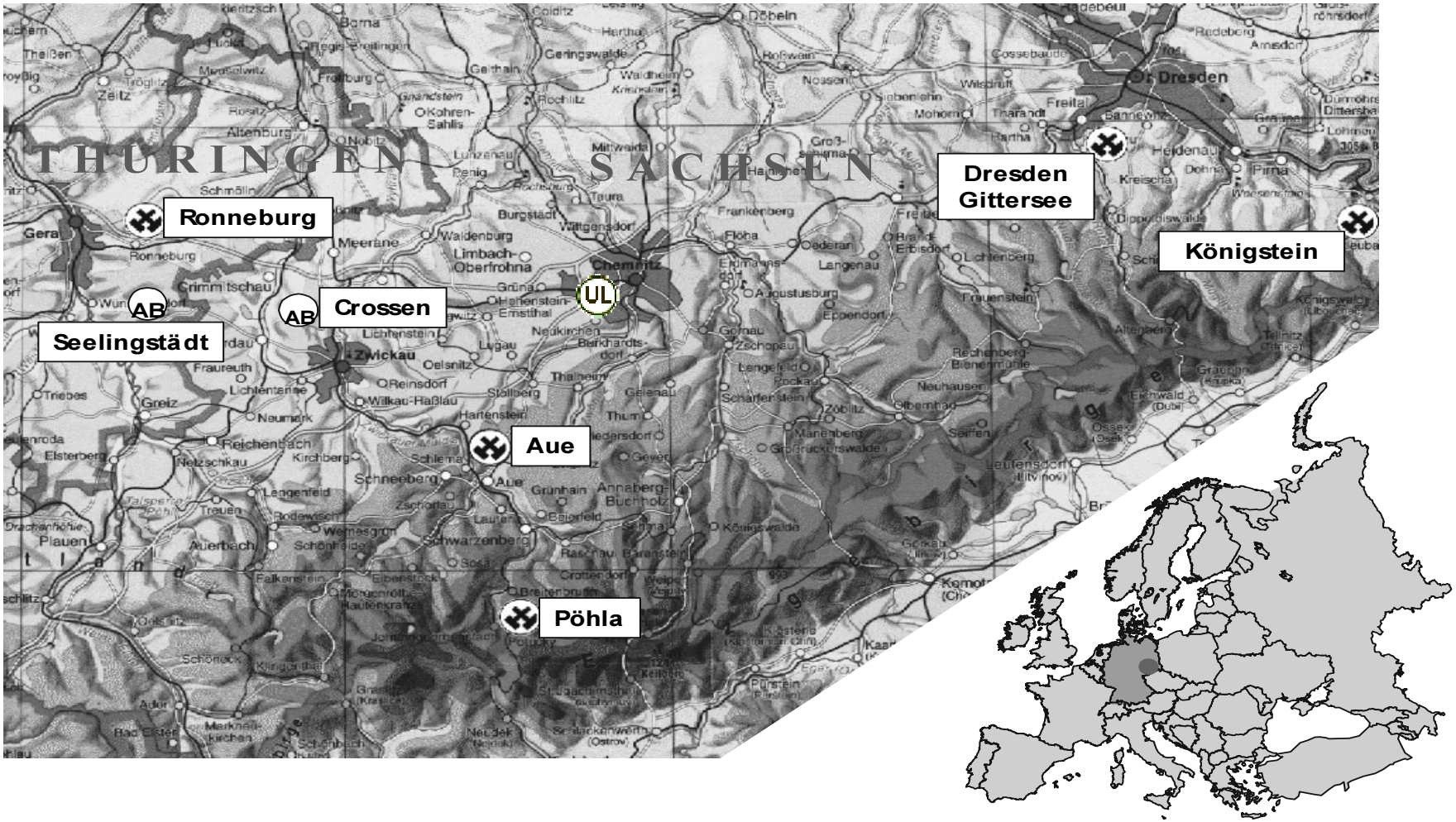
1954 Foundation of the bi-national Soviet-German company SDAG WISMUT, continuation of the uranium production with a workforce of up to 120‘000 employees.

until 1990 WISMUT produced 231’000 tonnes of uranium and had been the world’s third largest producer until that time

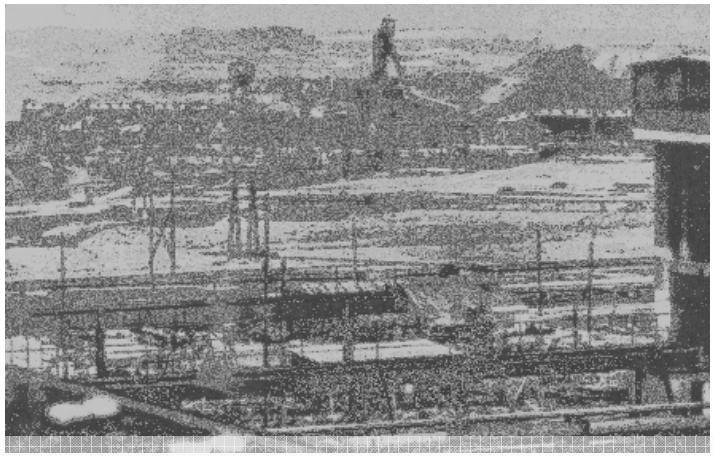
1990 Following re-unification of Germany, the uranium production was terminated in particular for economic reasons. WISMUT GmbH, with the Federal Republic of Germany as sole shareholder was built. Its corporate purpose is to decommission the former uranium mining and milling facilities and to rehabilitate the sites.

1991 The WISMUT Environmental Rehabilitation Project was initiated, the German Federal Government earmarked a total of € 6,6 billion (later updated to € 6,4 billion) to fund the Project.

# Location of the WISMUT sites



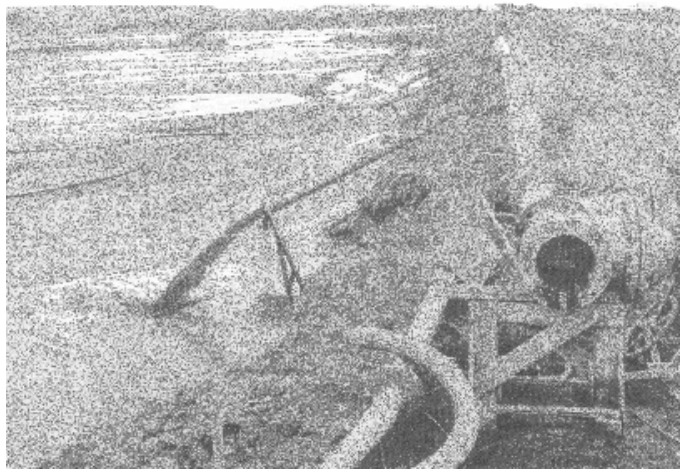
# Production phase 1946 – 1990



5 mines, 1 open pit , 3700 ha operational areas

64 mine dumps,311 Mio. $m^3$ waste rocks

2 processing plants, of 140 ha area



Tailings ponds, 570 ha, 178 Mio. $m^3$

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# Classes of objects - object-specific remediation technologies

| | |
|---|---|
| **Contaminated structures and areas** | Demolition, decontamination, clean-up of areas, Release of lowly contaminated material for restricted reuse, safe disposal of higher contaminated material |
| **Waste rock dumps** | In-situ remediation (re-shaping, slope stabilisation, covering); alternatively relocation to a safe site |
| **Tailings management facilities (TMF)** | Dry In-situ remediation (dewatering, geo-technical stabilisation, cover placement) |
| **Lichtenberg open pit** | Backfilling of waste rock material |
| **Mines** | Closure of mine openings, stabilisation of underground mine galleries, controlled flooding |
| **Contaminated water** **(mine water, seepage, TMF pore and supernatant water)** | Active water treatment in special plants, alternatively passive water treatment procedures (biological treatment technologies, phytoremediation, etc.) |

# Demolition of structures and clean-up of areas

Situation in 1991

October 2008

Demolition of the Seelingstädt processing plant

Release of not and lowly contaminated material for re-use (here: for scrap smelting)

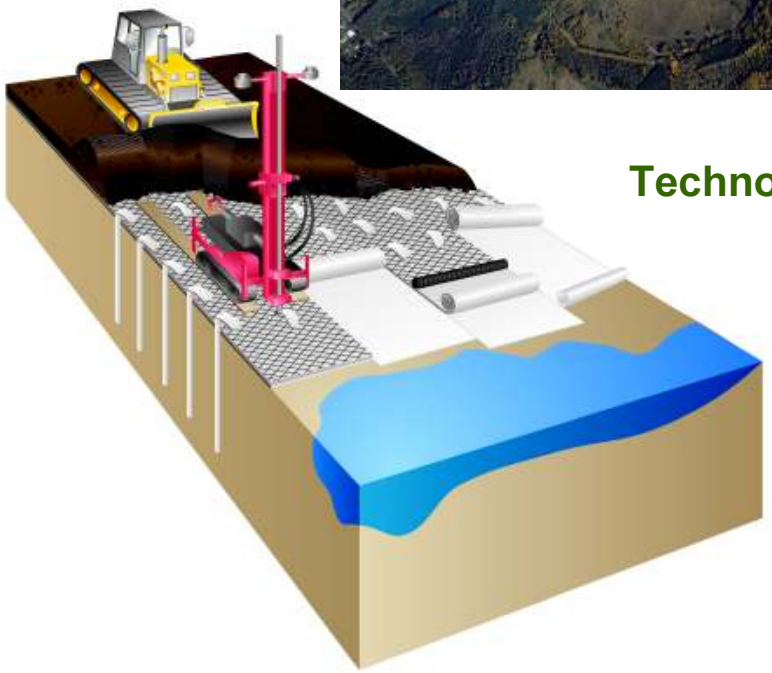
# In-situ remediation of waste rock dumps

(dump #366, Schlema-Alberoda)

**1994 1998**

**2000 2002 2008**

# Dry In-situ remediation of Tailings Management Facilities



**Technology**

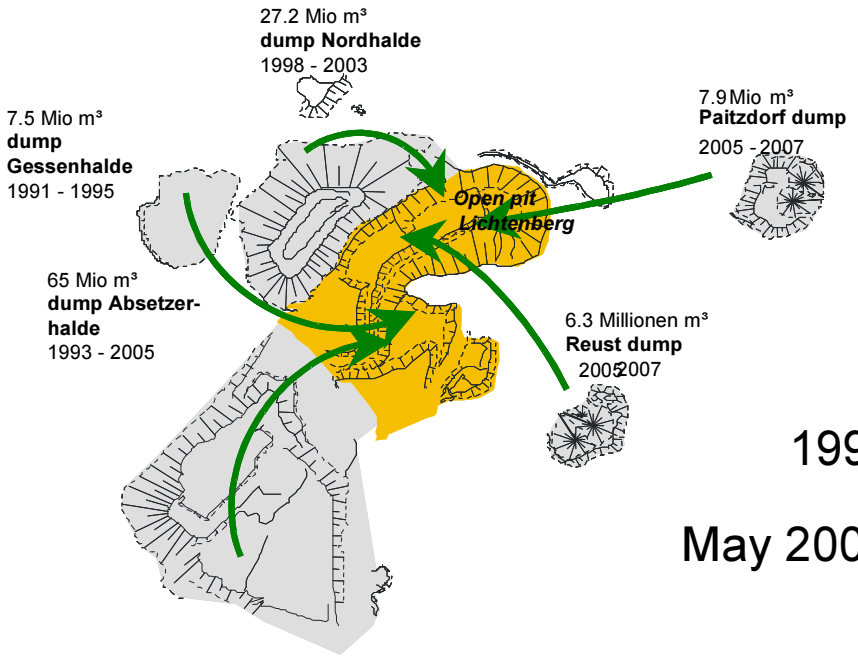
(a) Removal of the „free" pond water and pore water;

(b) Placement of an interim cover on the tailings surface to provide the consolidation load and create a stable working platform;

(c) Construction of a stable surface contour providing suitable run off conditions for the surface water;

(d) Capping of surface with a final cover

# Backfilling of the Lichtenberg open pit

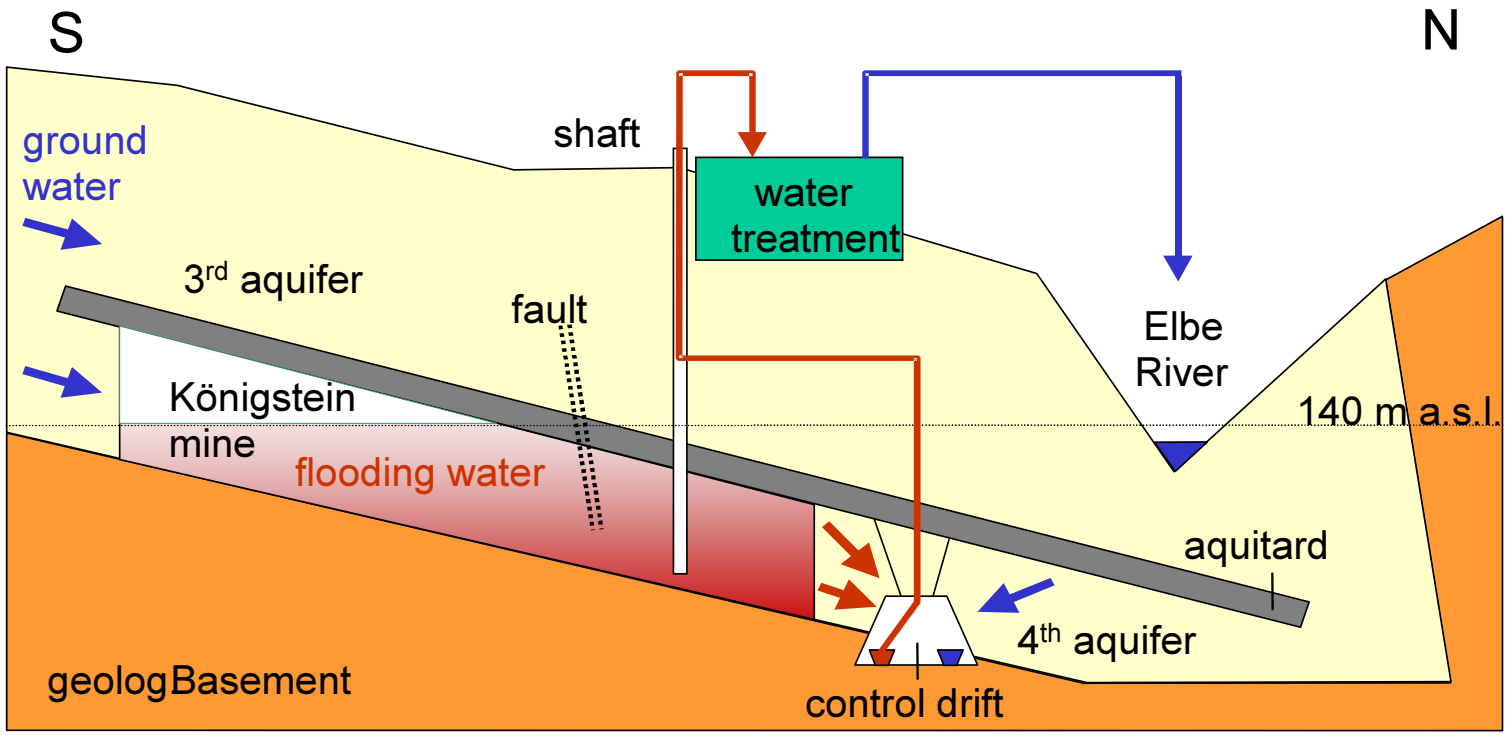



1991

May 2008

- **Operation:** 1958 – 1977
- **Dimension:** Area 160 ha,
  Length 2 km,
  Width 1 km
- **Volume:** 160 Mio. m³

# Controlled flooding of the Königstein mine



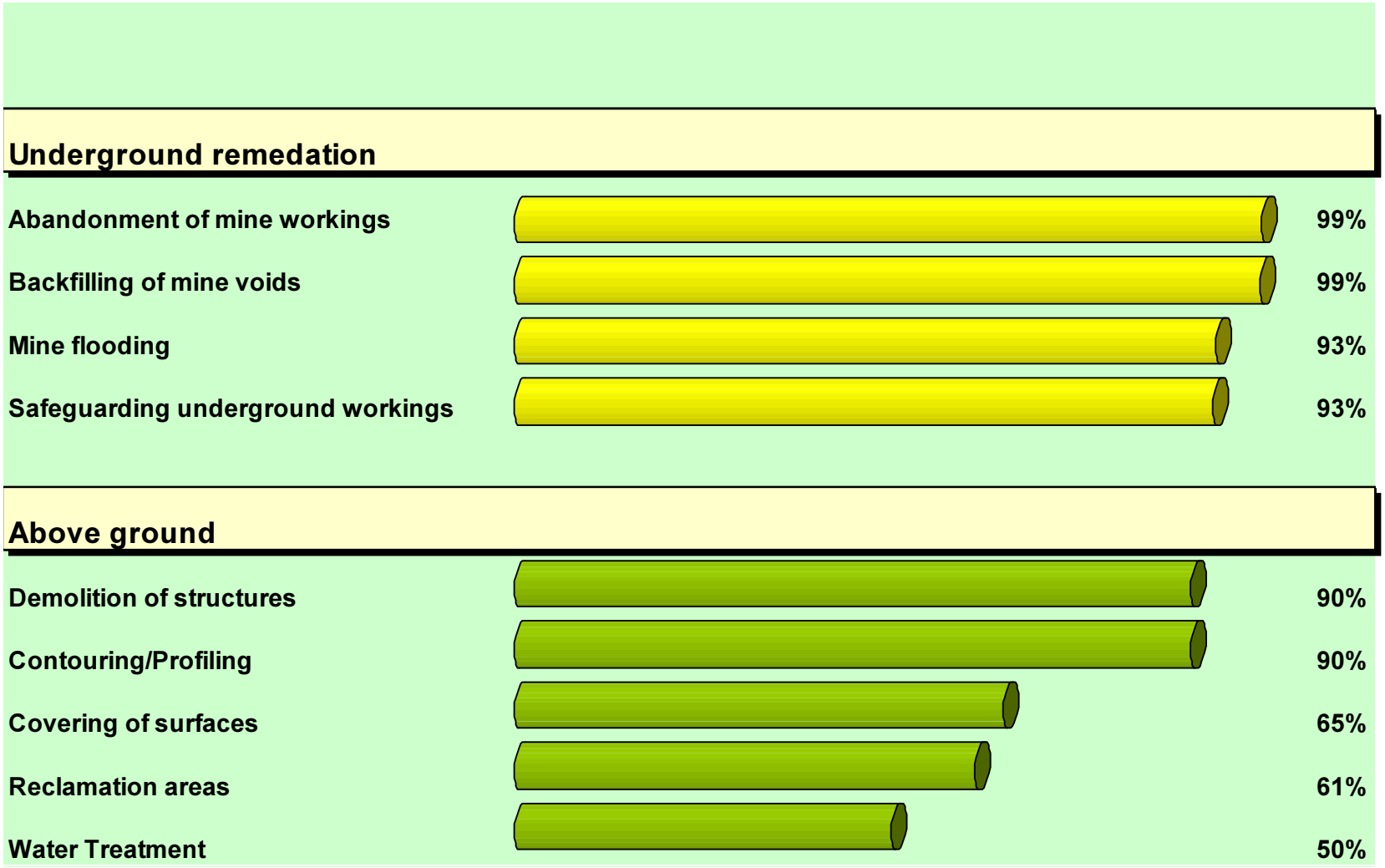
# Treatment of contaminated water

from sophisticated water treatment plants to passive water treatment facilities

**WTP Königstein**

**wetland Pöhla**

# State of Rehabilitation – March 2009

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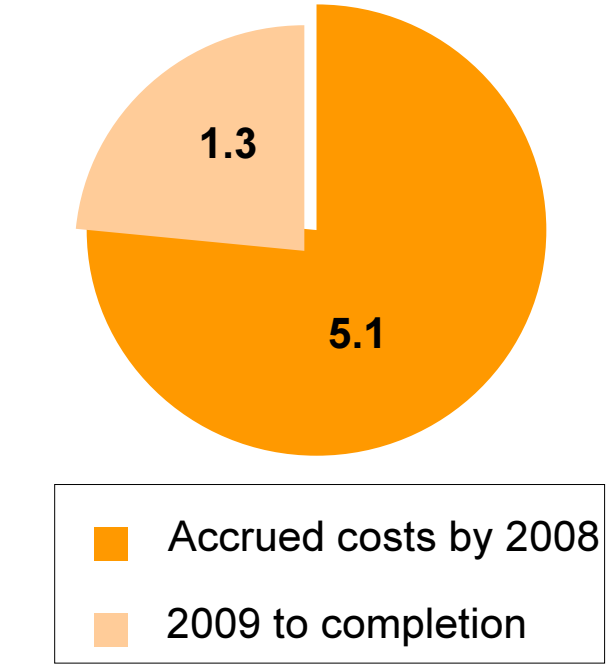
# Funding

(by the Federal Government, Ministry of Economics and Technology)

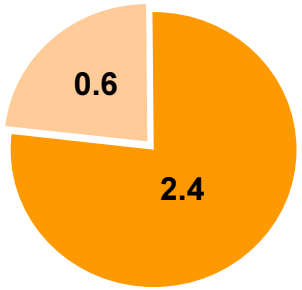
Wismut aggregate €6.4 bn.

(exclusively committed by the Federation)



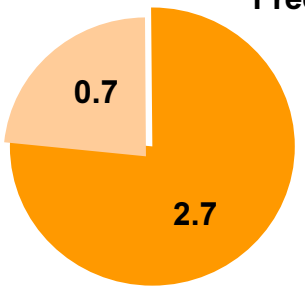

**Funding of remediation in the Free State of Saxony**

**€3.0 bn.**




**Funding of remediation in the Free State of Thuringia**

**€3.4 bn.**



## Lessons learned during almost two decades of implementation of the WISMUT Project

- Cost driving factors
- Clear definition of remediation criteria
- Proof of remediation success
- Model predictions
- New challenges
- Stakeholder involvement and regaining public trust

# Lessons learned: The eight cost drivers of the WISMUT projecting factors (1)

## Decommissioning / rehabilitation costs: 38 US $ per kilogram uranium produced

- Low grades (~ 0.1 % U): U / tailings = 825; U / total mine waste = 5,585
- Sulfidic & polymetallic nature of deposits: acid rock drainage, broad spectrum of contaminants of concern
- Humid climate (covers, water treatment)
- Radiological impact in a densely populated area
- Lack of sustainability of former mining
  - No parallel remediation, no prevention
  - Acid UG Leach Mining in a sensitive area
- Unplanned stop of production with no closure strategy
  - Sub-optimal legacy situations to start with (e.g. TMFs)
  - No permits available, substantial standby costs !
- New, stricter regulations superimposed to an „old“ system
- Social cost included: Staff reduction from 45,000 employees (1991) to 1,700 (2008)

# Lessons learned: The eight cost drivers of the WISMUT projecting factors (2)

## ... and what we can learn from:

- Plan with the closure in mind from day one.
- Invest in Prevention to prevent long term liabilities.
- Start early with partial rehab work.
- Concerning the closure plan:
  - See your site as a whole (conceptual site model)
  - Take care of uncertainties in data & knowledge
  - Beware of extreme events (e.g. floods)
  - prefer „nature-close“ remedial options instead of sophisticated engineered facilities (also with respect to long-term cost minimization)
- Realize early involvement of all relevant stakeholders as key to acceptance !

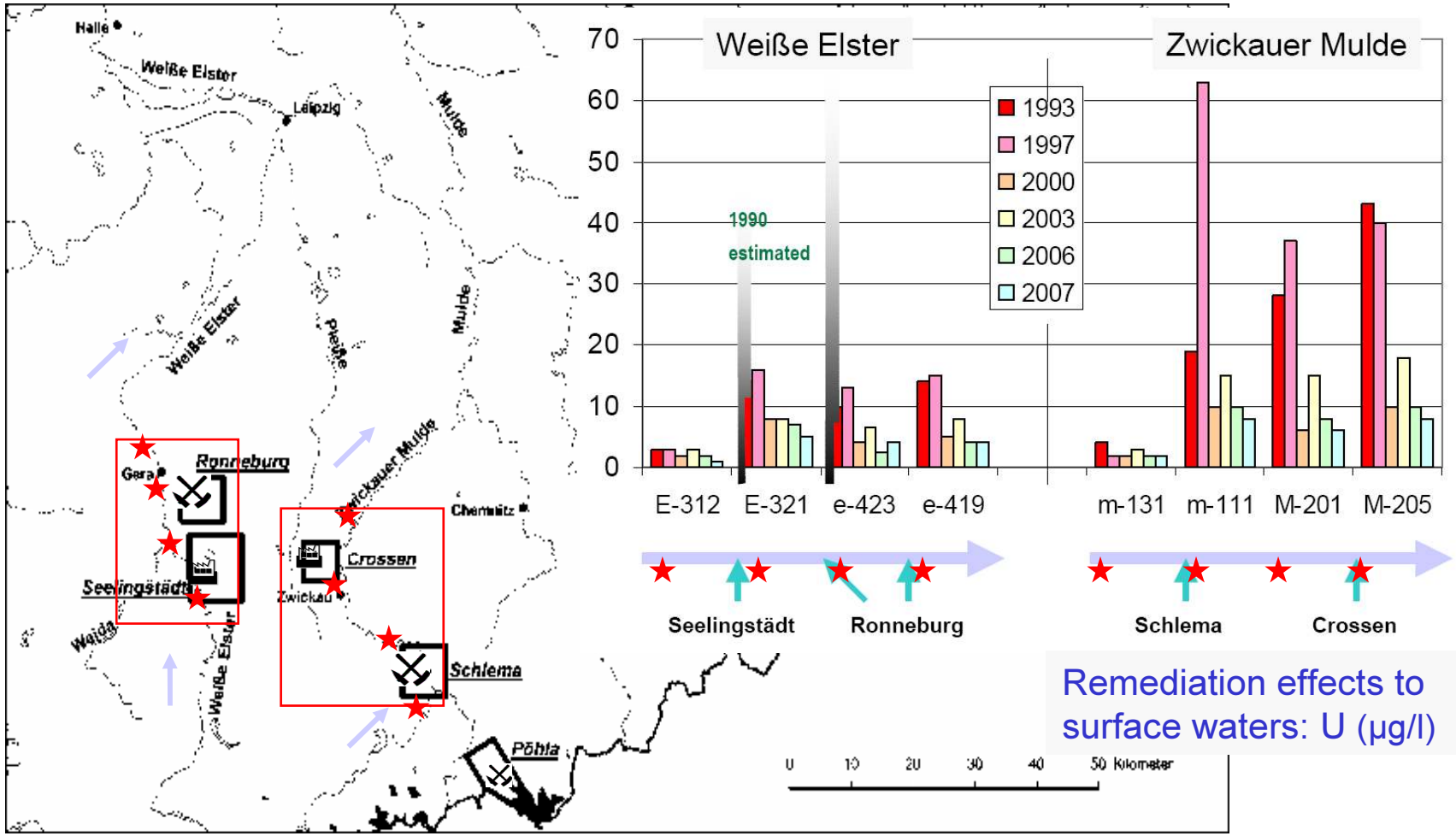
# Lessons learned: Need for clear definition of remediation criteria

- make decisions transparent for authorities and stakeholders as well, to guarantee acceptance in the decision process
- develop site-specific remedial measures; no „blind standard application“

With respect to radiation protection:

- 1 mSv/a reference value to decide on justification of measures (application of the 10 mSv/a intervention level for existing situations is not accepted by stakeholders)
- application of appropriate and for stakeholders easily understandable optimisation procedures (cost-benefit of multi-attribute analyses ?)
- 1 mSv/a also as a target ?
- radiation protection criteria to be weighed against other criteria !

# Lessons learned: Need for proof of effectiveness of remedial measures (1)



# Lessons learned: Need for proof of effectiveness of remedial measures (2a)


May 1999

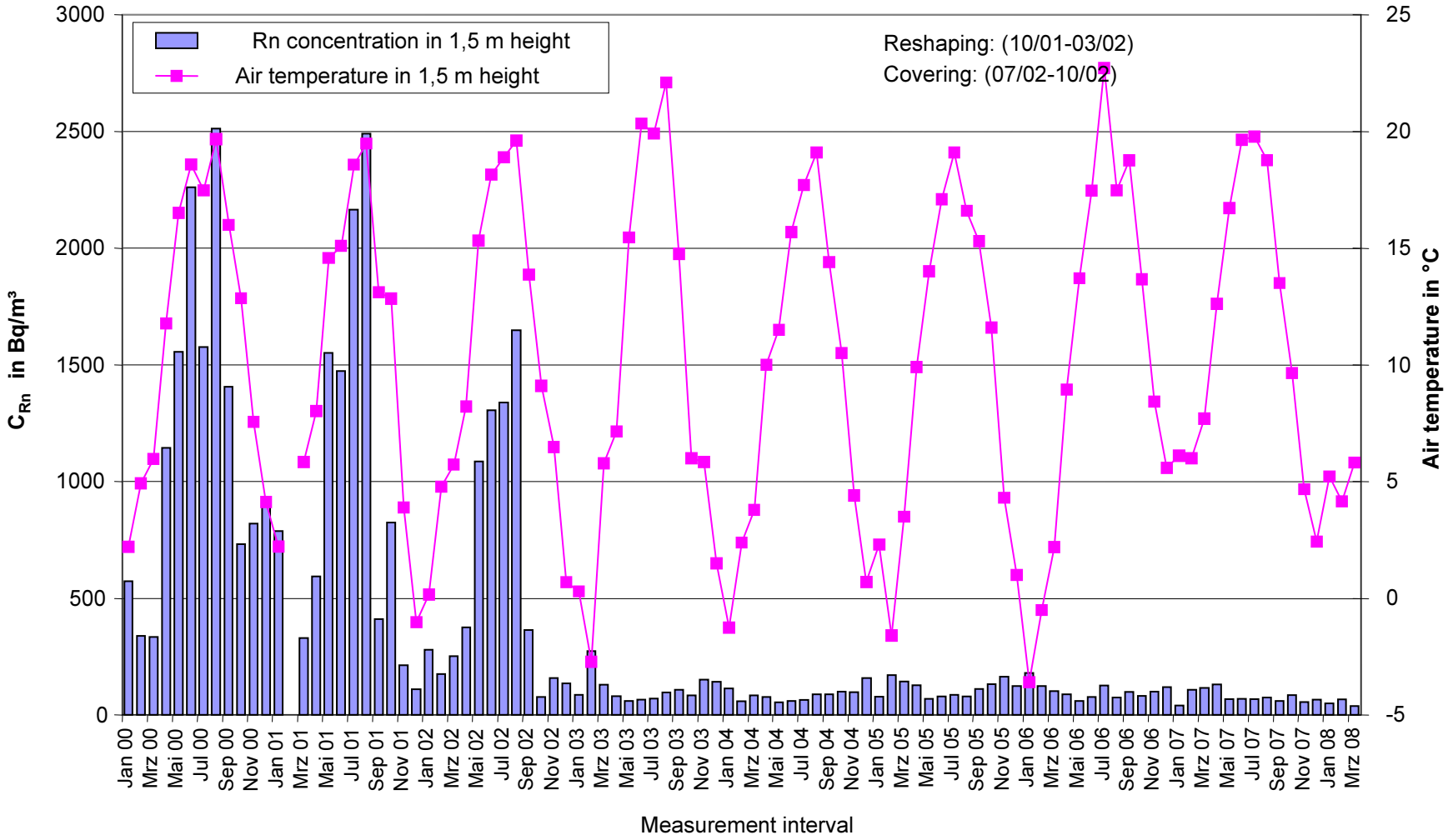
July 2002

April 2003

**Continous measurements with a Rn monitor**

**before remediation: ø > 1000 Bq/m³**
**max. 2500 Bq/m³)**

# Lessons learned: Need for proof of effectiveness of remedial measures (2b)

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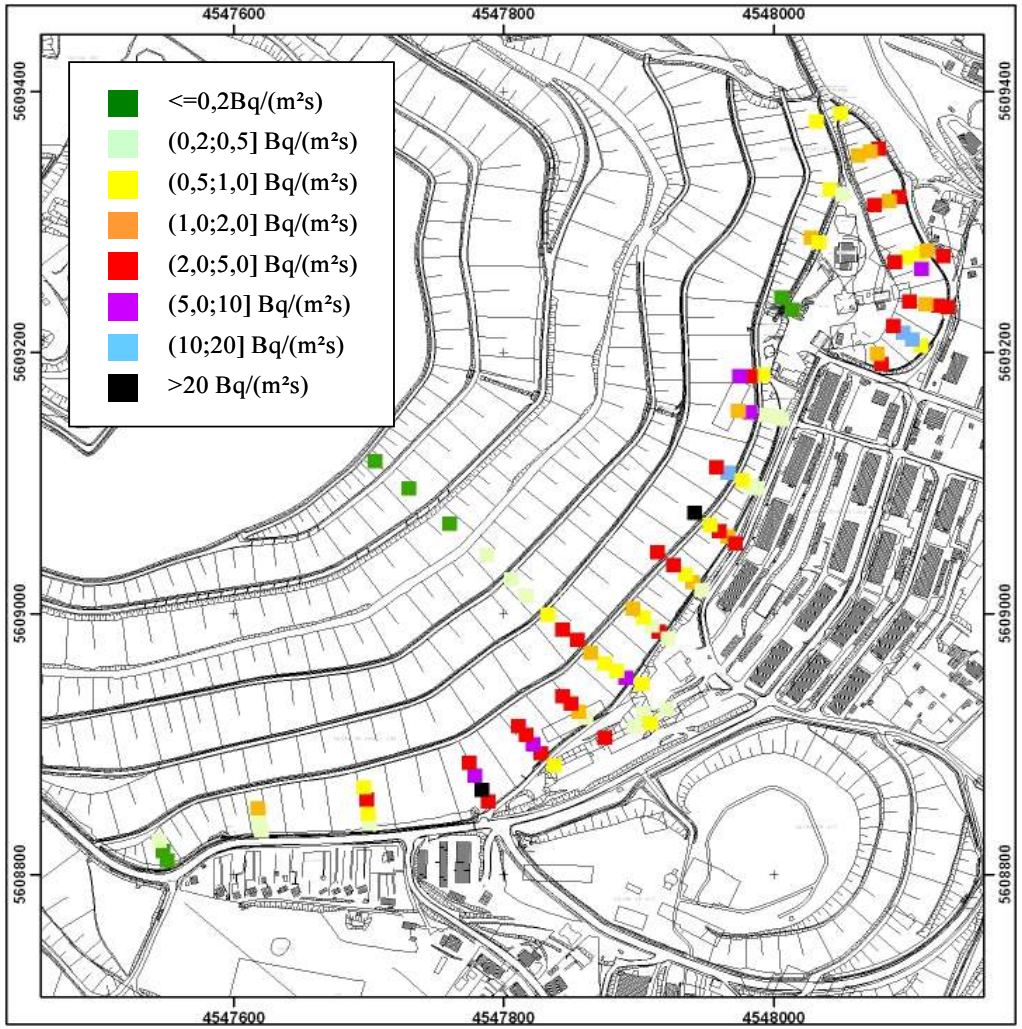
# Lessons learned: Not all model predictions materialize !




Radon exhalation rate at a big already covered waste rock pile in Schlema:

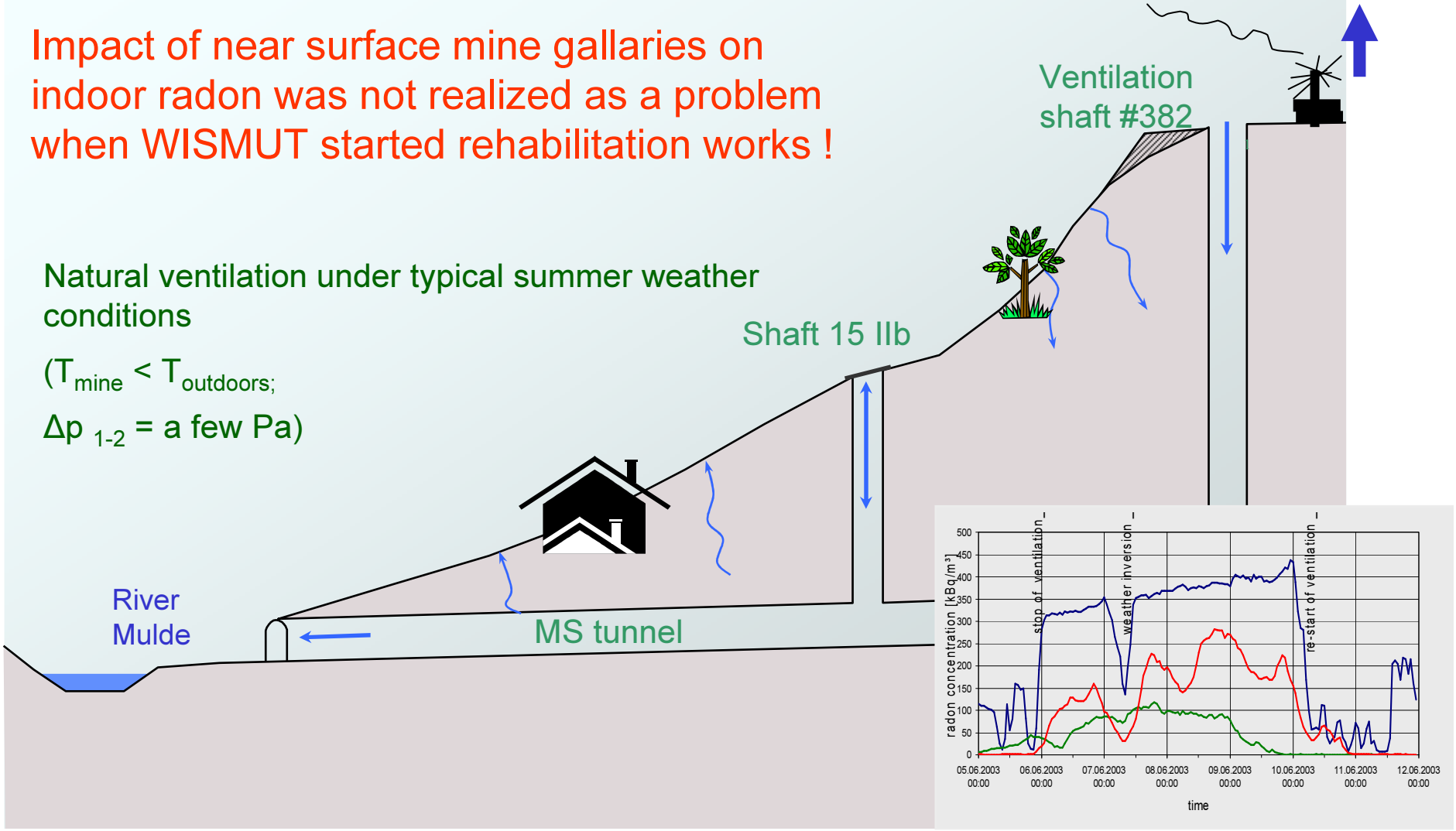
# Lessons learned: New challenges during rehabilitation

Impact of near surface mine gallaries on indoor radon was not realized as a problem when WISMUT started rehabilitation works !

Natural ventilation under typical summer weather conditions

($T_{mine} < T_{outdoors}$;

$\Delta p_{1-2}$ = a few Pa)



# Lessons learned: Stakeholder involvement and regaining trust of the public are indispensable

## Building Bridges with the Public - The WISMUT Policy -

- implementation of the project with the staff of the former mining company SDAG WISMUT
- involvement of local experts and companies (social factor)
- „opening of the books“; openness, frankness, - in particular disclose of data on environmental pollution
- involvement of the local public in decision making; stakeholder involvement in general
- sustained public relation policy
- preservation of mining traditions
- returning the WISMUT legacy to productive use (best way to ensure sustainability of remediation)

# Lessons learned – “building bridges”

WISMUT
exhibition hall
Ronneburg site

Preservation of
mining traditions

Public relation in action:
annual on-site “Visitor’s Day”

# Lessons learned: Sustainability means returning WISMUT legacies to productive reuse

Bad Schlema: Conversion of a devastated uranium mining site back to a radon health spa

Gulf course construction on a covered waste rock dump

To date, approx. 650 hectares of reclaimed areas have been sold by WISMUT.

# Long-term and post-remedial tasks:

## Post-remedial phase: 5 years

= Period during which proof of the efficiency of the performed remediation measures is to be furnished
[e.g. accounting for physical modifications that covers will undergo during the post-construction period]

## Long-term tasks: 30 years (estimate)

## The long-term and post-remedial activities include:

- Water treatment (will need to go on for decades (> 30 years ?))
- Long-term environmental monitoring
- Care and maintenance of restored land
- Care and maintenance of ancillary mine workings
- Mine damage control and compensation
- Long-term data management, documentation


Thank you for
attention
WISMUT