

# **Development of repository concepts in crystalline rock (in Germany)**

**Round Table**

**„The use of underground space to solve nuclear power engineering tasks“**

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BGE TECHNOLOGY GmbH**

**01/2019  
Moscow**

# BGE TECHNOLOGY – The Company

## Our Activities

International consulting and engineering company in the fields of radioactive waste management, mining and related subjects

## Our Clients

Energy, waste management and mining companies as well as expert organisations and authorities

## Our Shareholders

**100 % BGE**  
(Federal Organisation for Radioactive Waste Disposal)

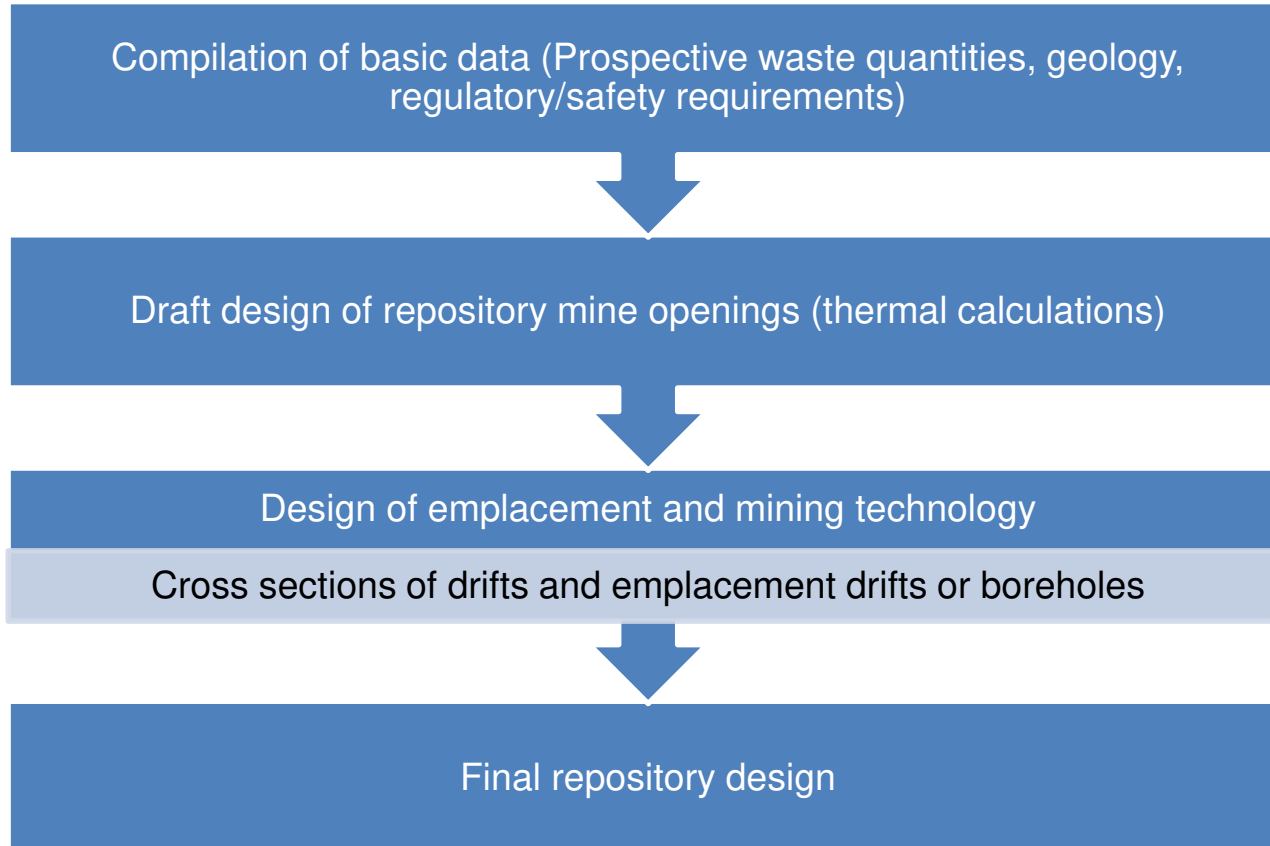
## Our Team

**> 30 highly qualified and motivated scientists and engineers**

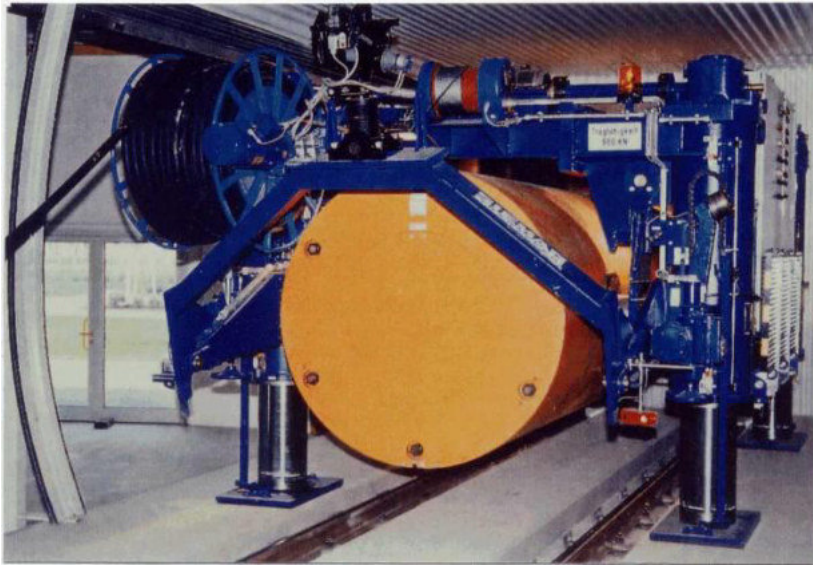
# Content

1. General approach of planning a repository concept
  - Waste transportation technology
  
2. Design approach for a repository in crystalline rock
  - Repository mine design

# 1. General Approach of Planning a Repository Concept (simplified)



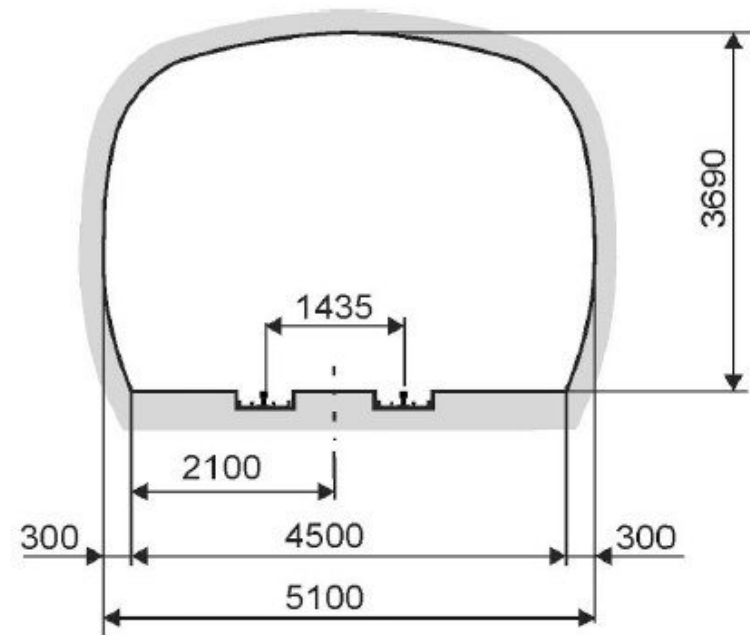
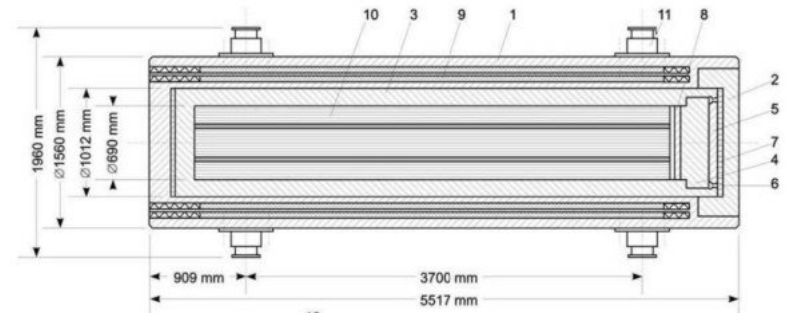
# 1. Emplacement Technology – in Drifts



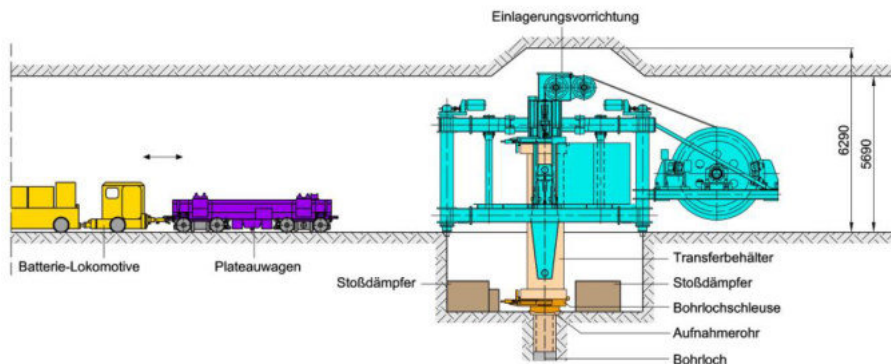
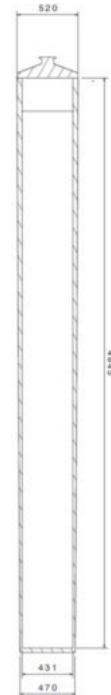
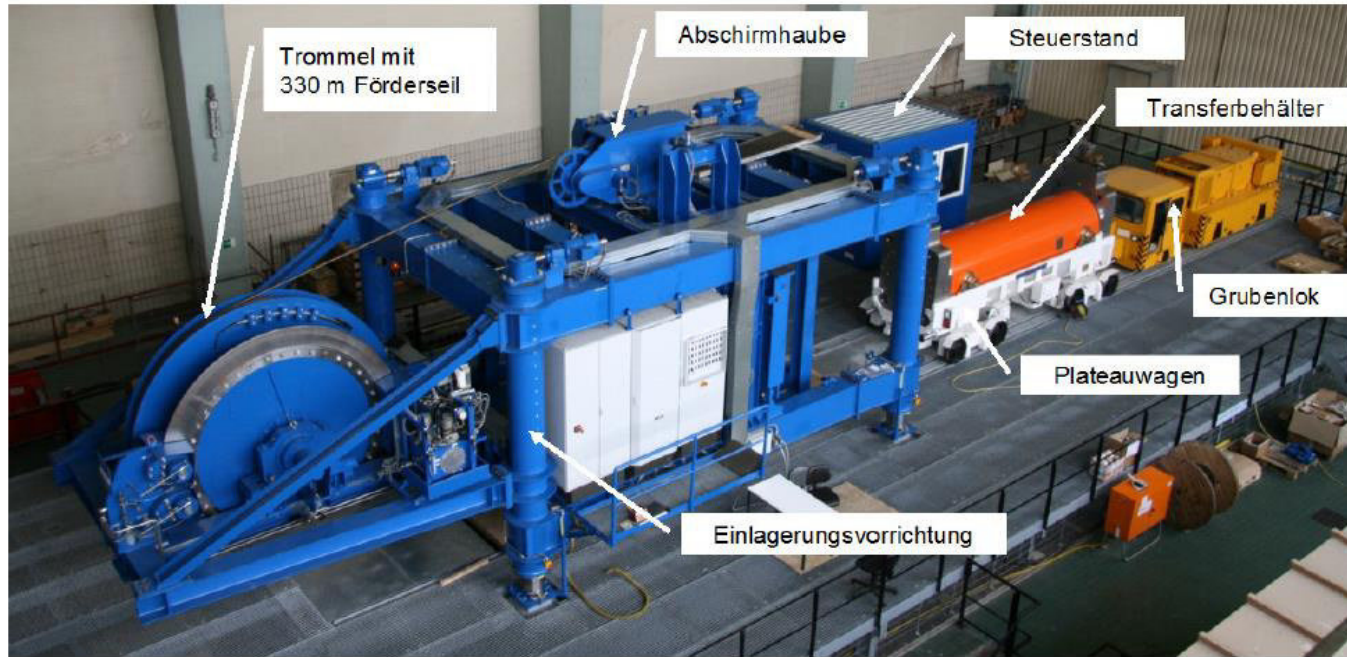
Demonstration test in 1:1 scale

Main waste cask:

2200 x POLLUX<sup>®</sup> -10, 65 t, with spent fuel elements



# 1. Emplacement technology – in vertical boreholes

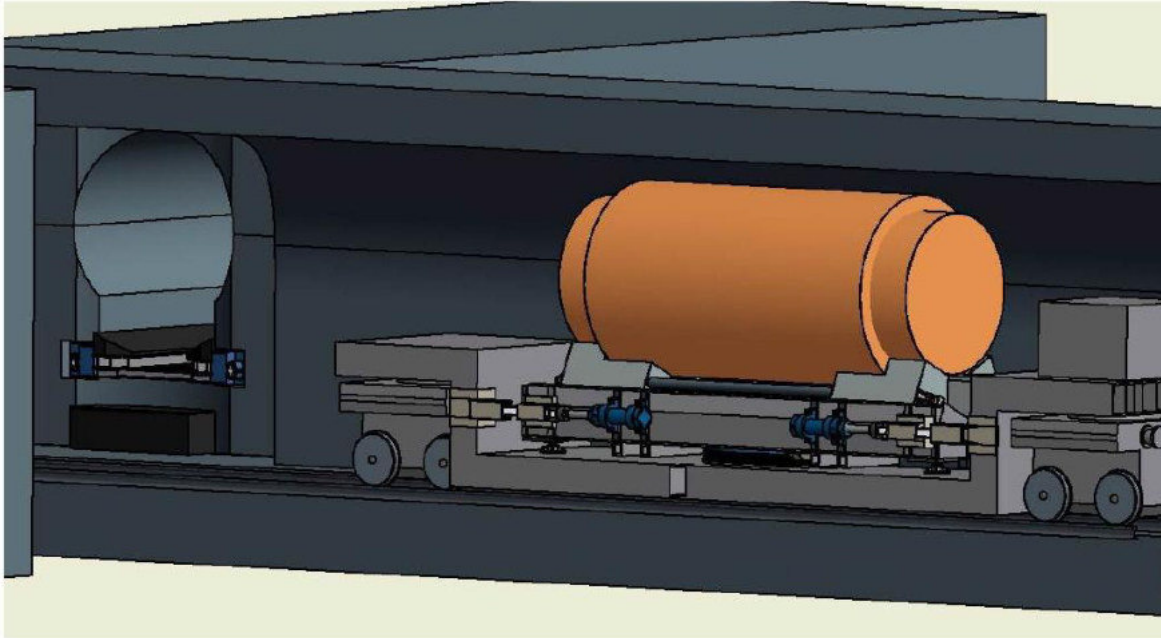


Demonstration test in 1:1 scale

Main waste cask:

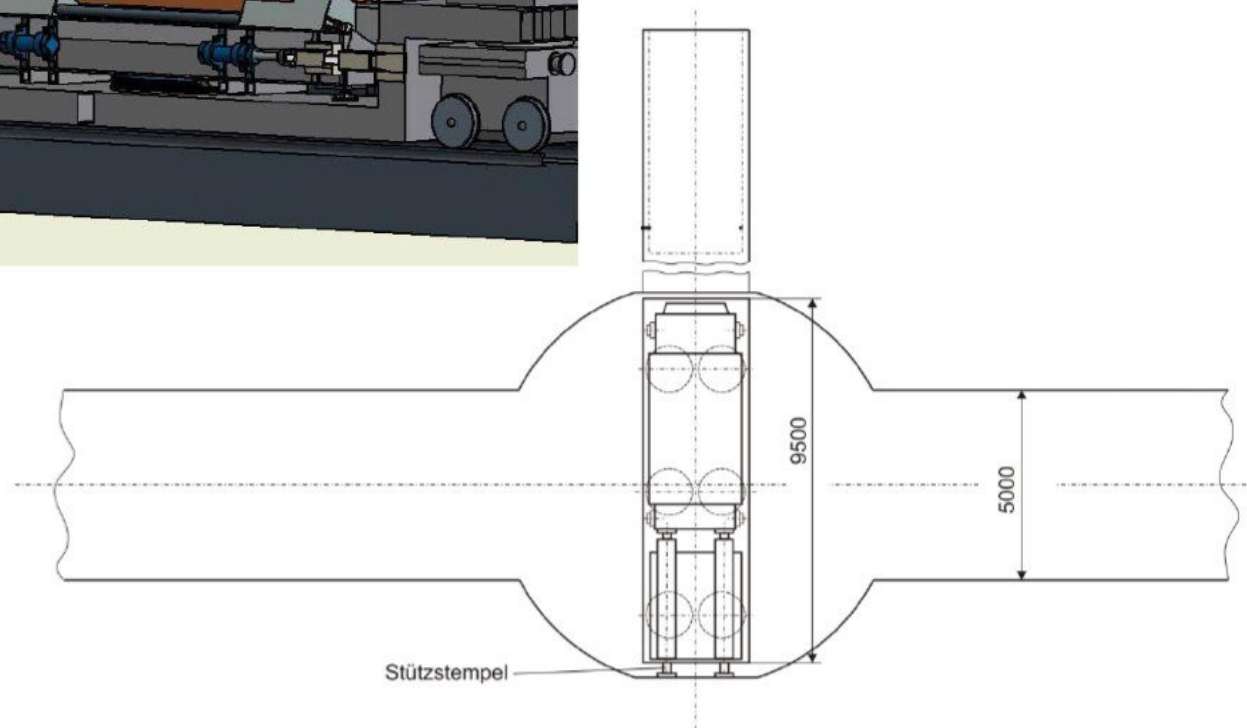
7000 x BSK-V, 5.3 t, with spent fuel elements

# 1. Emplacement technology – direct disposal of transport and storage casks



Conceptual design

Main waste cask:  
1100 x CASTOR® casks  
Diameter: 2,5 m  
Length 6 m  
Weight: 110 - 126 t

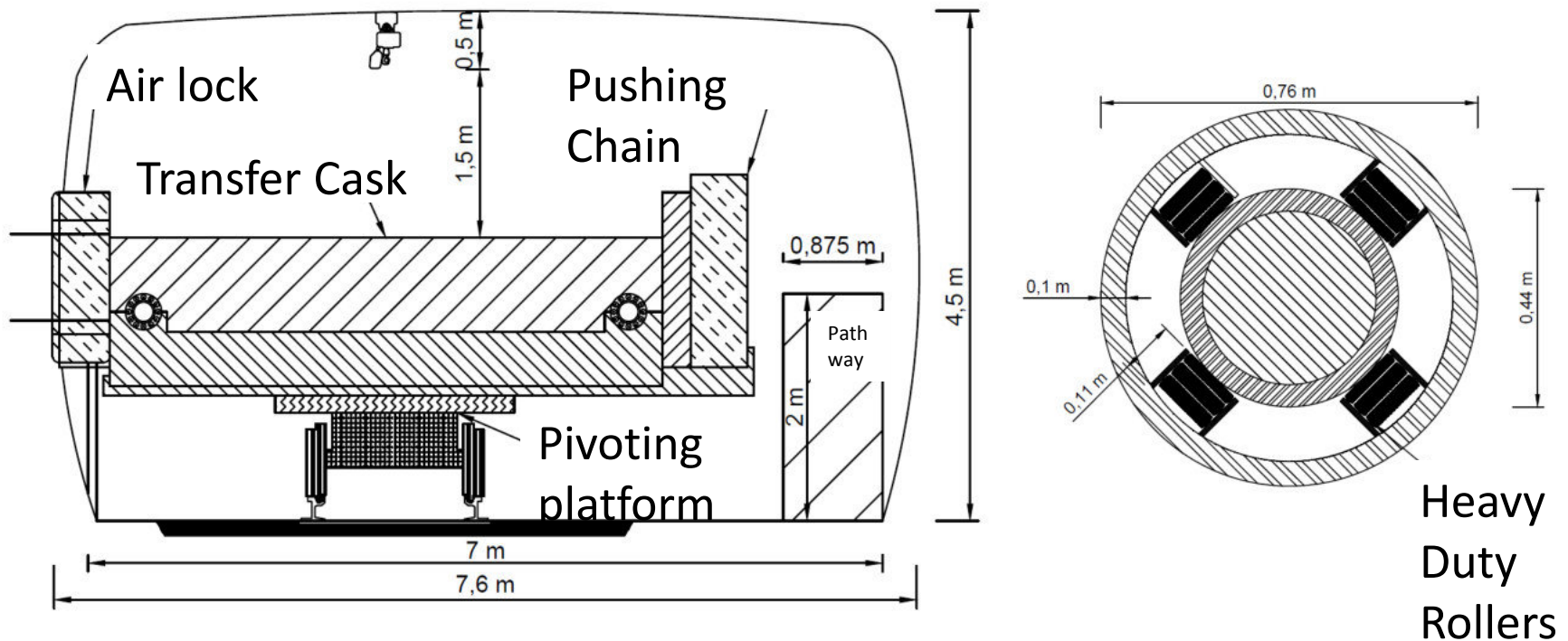


# 1. Emplacement technology – in horizontal boreholes

Draft design

Main waste cask:

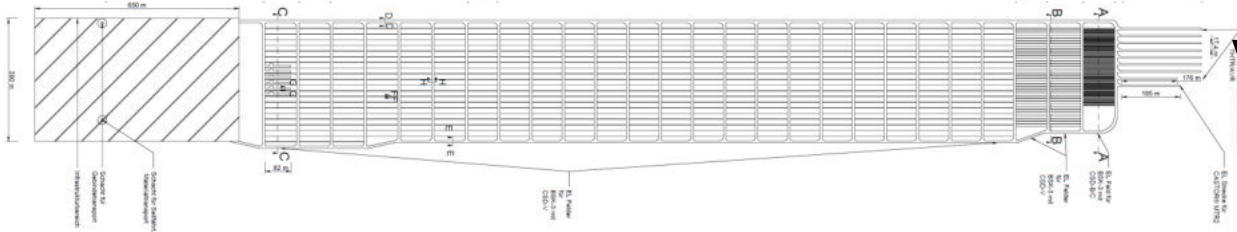
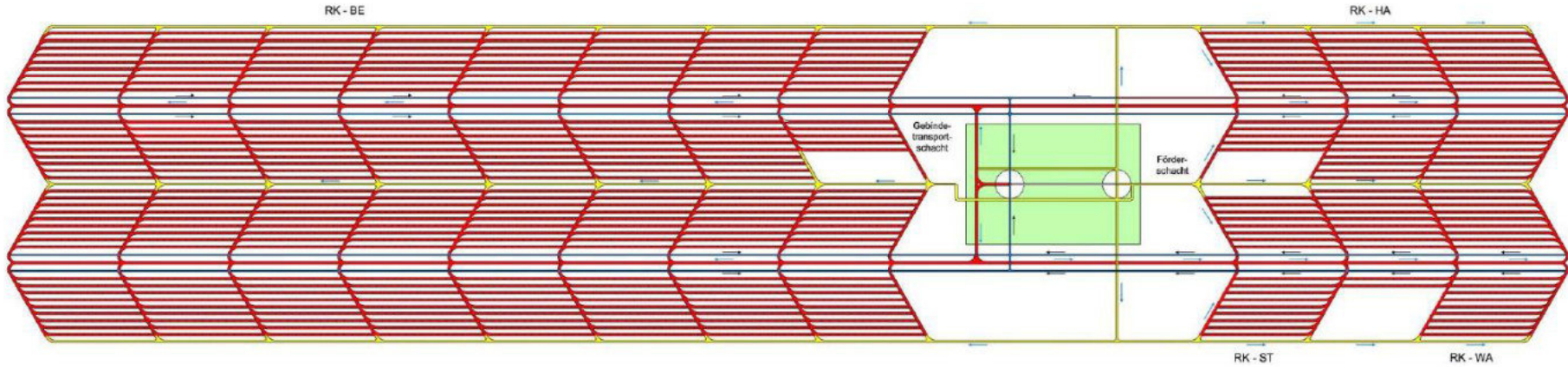
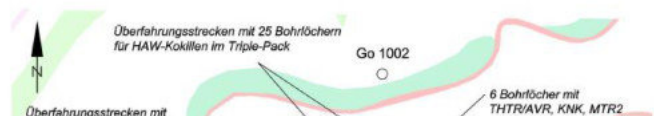
7000 x BSK, 5.3 t, with spent fuel elements





# 1. Underground Layouts

Gorleben salt dome



horizontal boreholes in bedded salt

vertical boreholes in clay

## 2. Knowledge Base (Crystalline Rock)

### Prospective waste quantities and requirements

- Amount and type very exactly know due to nuclear phase out
- waste casks? R&D activities launched



### Geology:

- summary in R&D study Jobmann et al. 2016 (crystalline rock)
- parameters from underground laboratories



### Transport, emplacement and mining technology

- Mining technology: state of the art
- Transport and Emplacement technology: built and tested or conceptual designs



## 2. Results of an R&D Project (KONEKD)

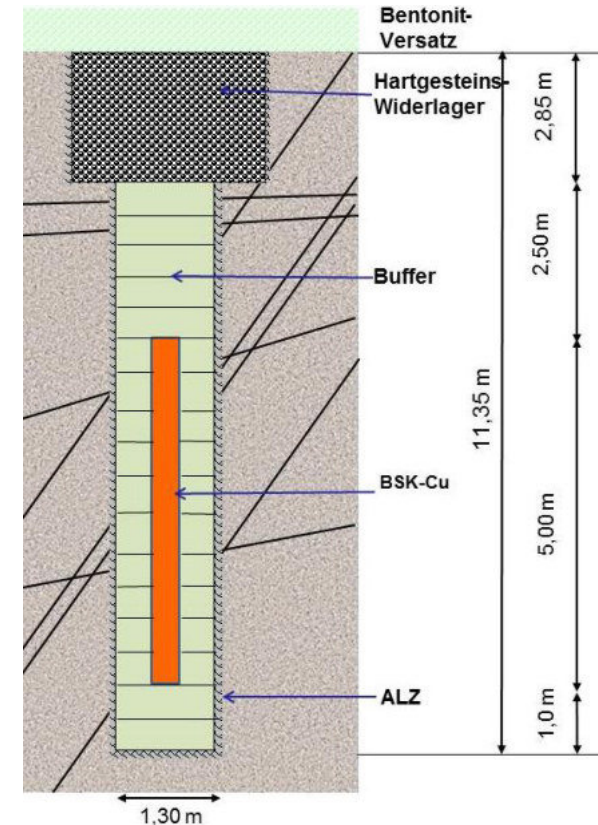
### Starting Point: KBS-3 Concept (SKB)

### Additional Requirements

- waste casks have to provide 1.000.000 years of containment
- retrievability during operational period

### Technical Concept

- copper shell + clay buffer
- Abutment above the buffer to hold it in place



## 2. Results of an R&D Project (KONEKD)

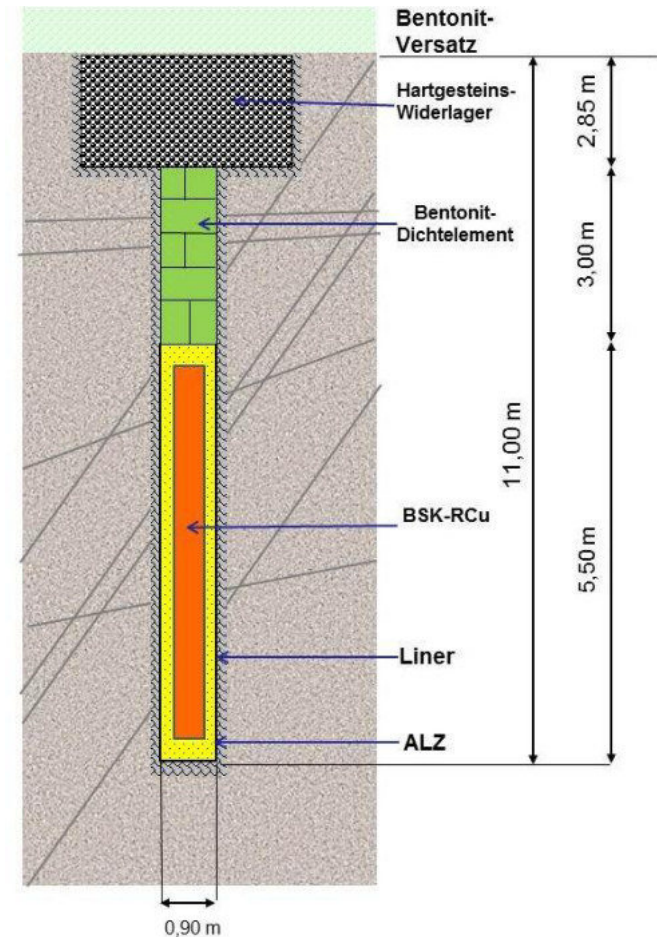
### Alternativ Approach: Multiple CRZ

### Special Requirements

- 1.000.000 years of containment
- retrievability during operational period

### Technical Concept

- borehole filled with sand
- long term containment by thin copper shell, host rock and seals
- Borehole liner between buffer and host rock



## 2. Results of an R&D Project (KONEKD)

### Alternativ Approach:

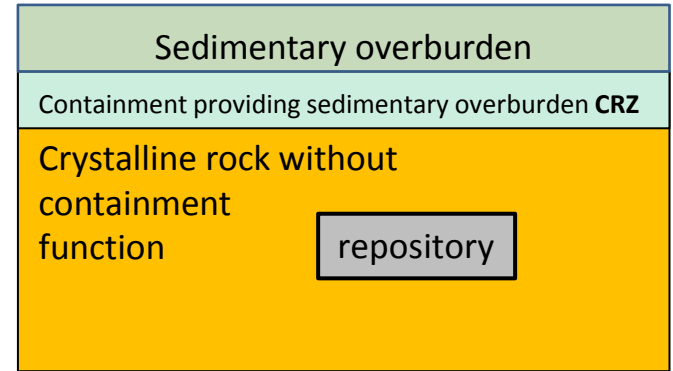
### CRZ in Sedimentary Overburden

### Additional Requirements

- 1.000.000 years of containment
- waste casks stays competent for recovery for 500 years
- backfill/seals underground provide obstruction for fluid migration

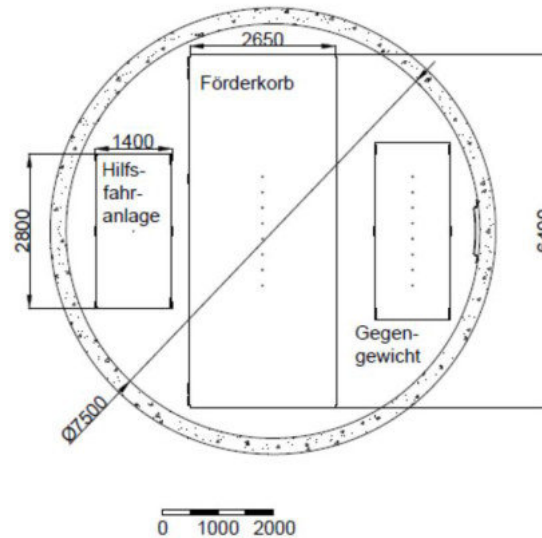
### Technical Concept

- steel waste casks (POLLUX<sup>®</sup> - type)
- redundant und diverse sealing elements in the shafts/ramps to the surface provide long-term containment

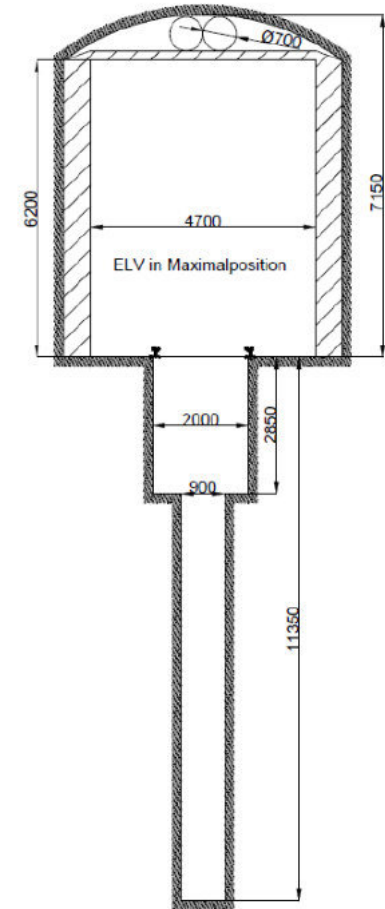


## 2. Underground openings (exemplary)

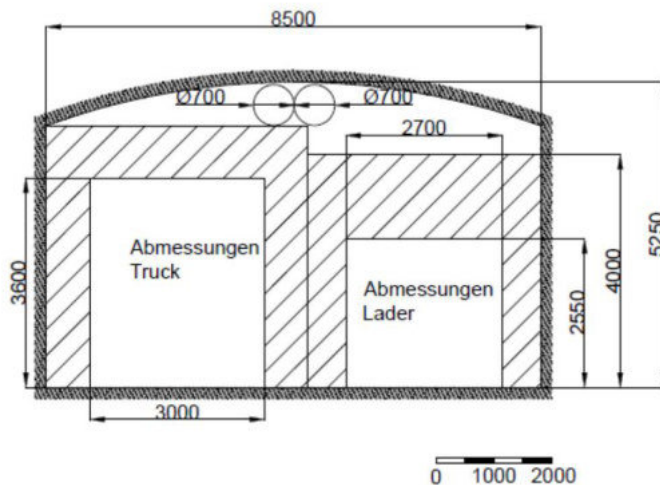
Shaft cross-section  
(Transport of waste casks)



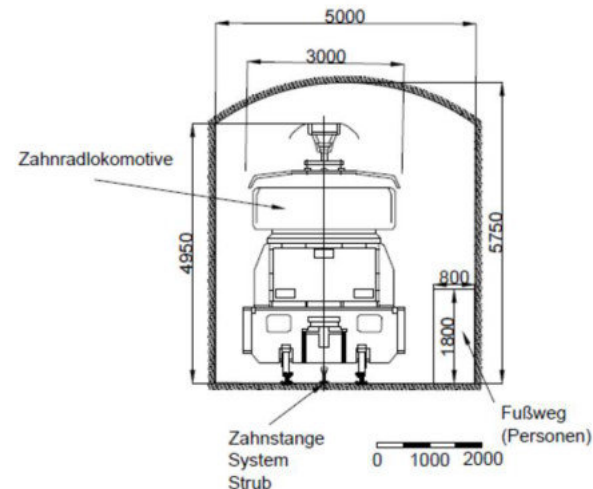
Emplacement drift for vertical boreholes



Drift for bulk transport

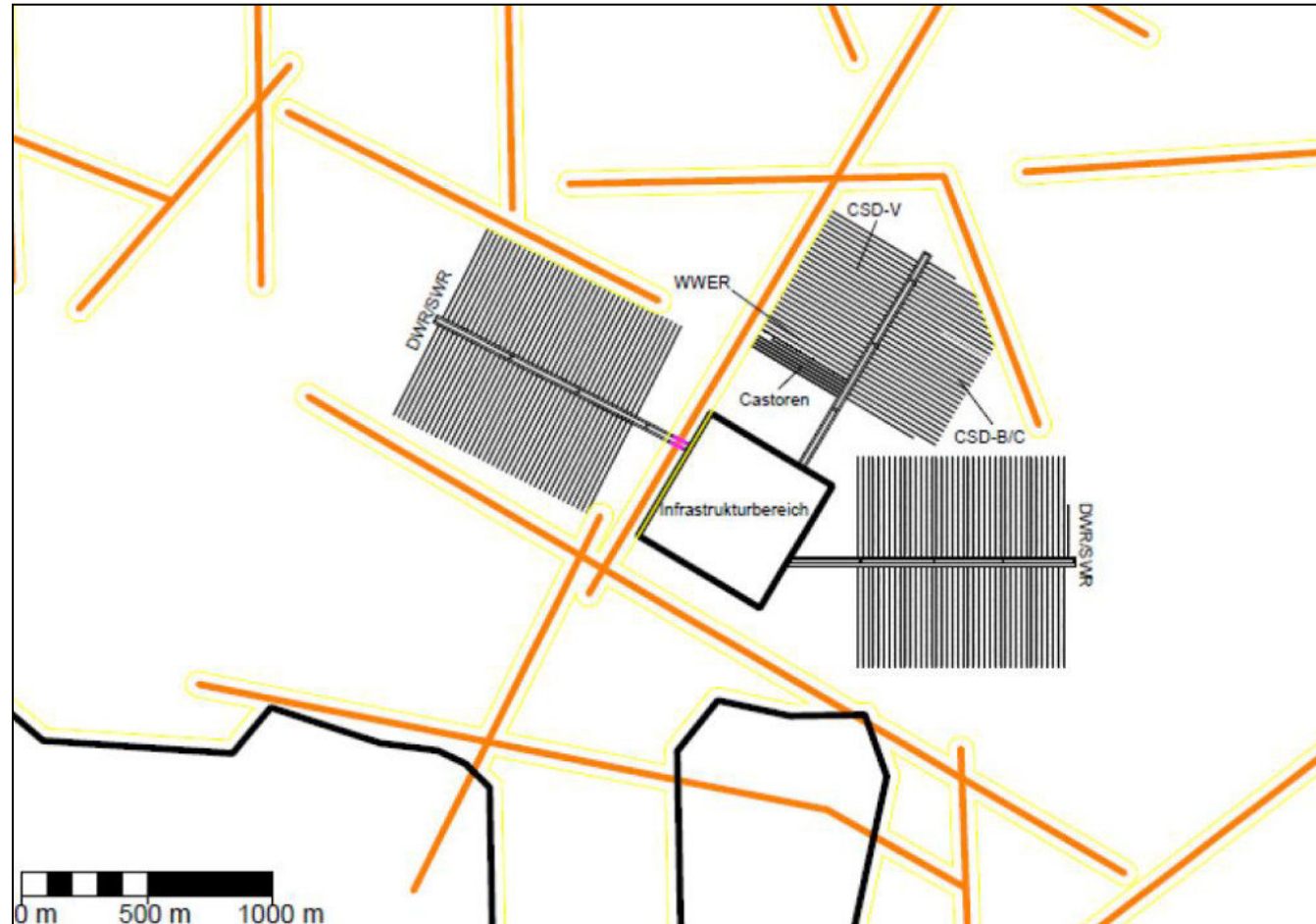


Rack & pinion railway in ramp



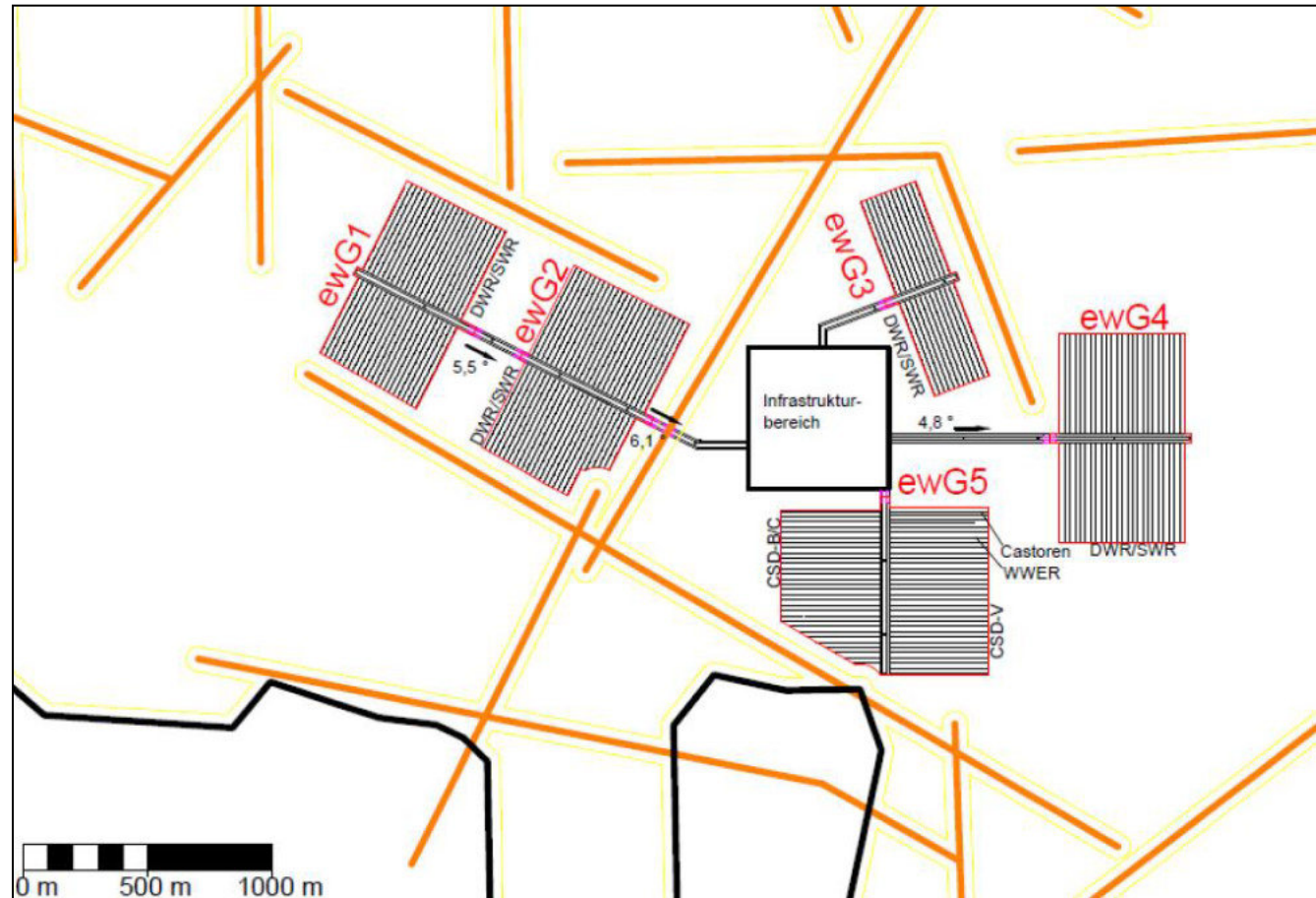
## 2. Repository layout – Mod. KBS-3 concept

Area  
2,8 km<sup>2</sup>



## 2. Repository layout – Multiple CRZ

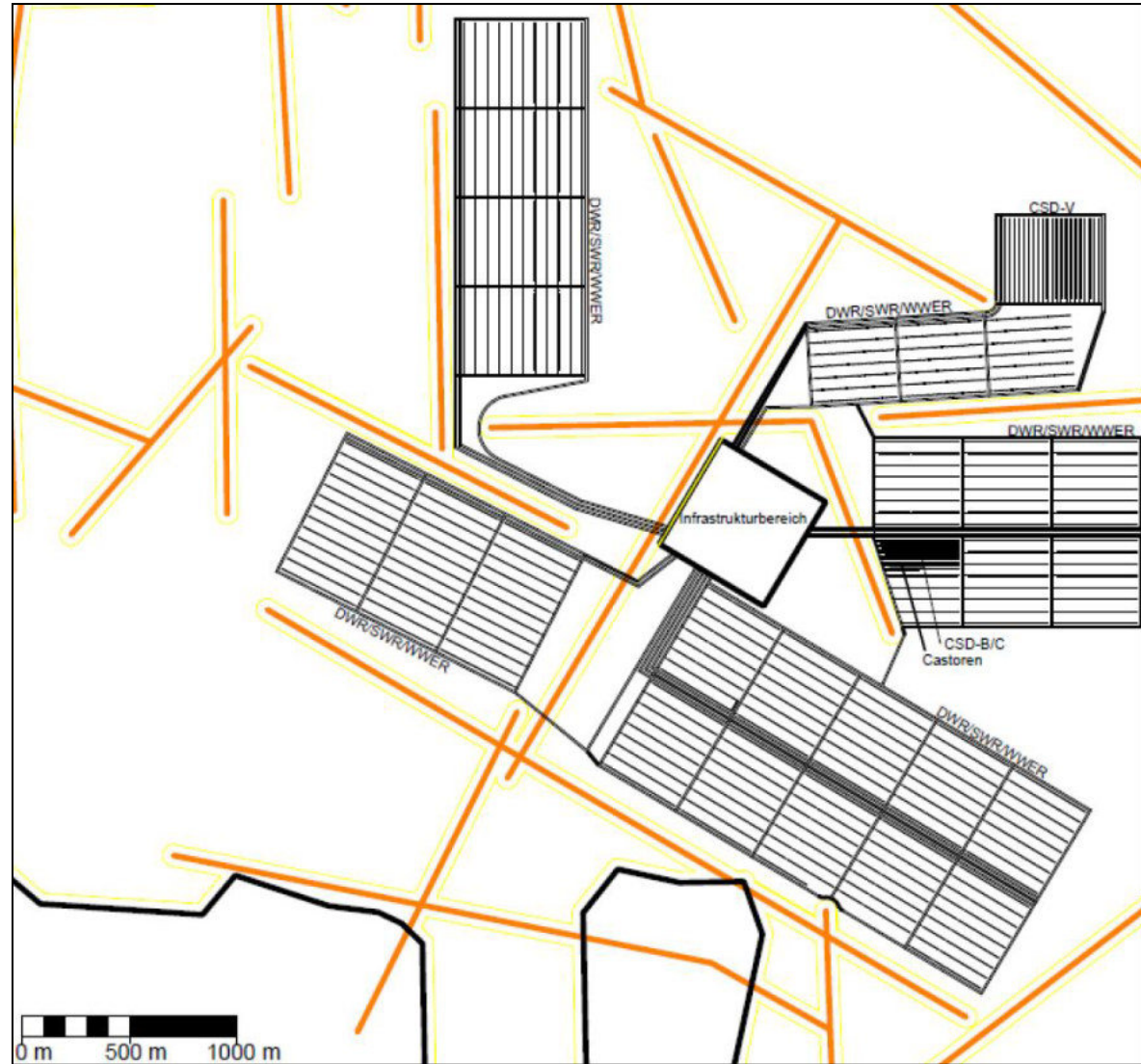
Area  
3,5 km<sup>2</sup>





## 2. Repository layout – CRZ in sedimentary overburden

Area  
7,4 km<sup>2</sup>



# Summary

