The Planning of a Gas Storage Facility
Basis for an Investment Decision

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Fall 2006 Conference
1-4 October
Rapid City, South Dakota, USA
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Possible Reasons for Gas Storage

- Security of Supply (short-term / long-term fluctuations)
- Independence from External Gas Suppliers
- Pricing of Competing Energy Suppliers
- Favorable Infrastructure Boundary Conditions
Basic Data for Planning

- Location
- Working Gas Volume
- Pipeline Pressure

- Concept of Storage Operation
  (peak shaving / seasonal storage)
  - Gas Withdrawal Rate
  - Gas Filling Rate
Location Selection

- Size / Simplicity of Salt Structures
- Depth of Structure
- Pipeline Network
- Fresh Water Supply
- Disposal of Brine
Geological Tasks

- Lateral Structural Setting
- Local Internal Structural Setting
- Identification of Soluble or Insoluble Layers
- Vertical Profile of Dissolution Rate
- Selection of Lithologic Intervals
Geological Tasks

Exploration Programme:
- Exploration Wells
- Gravimetry
- Seismic

Higher Intensity of Exploration
⇒ Reduction of Geological Risk
Rock Mechanics

Geometry parameters
- \( s \) = Salt roof thickness
- \( z \) = Cavern roof depth
- \( h \) = Cavern height
- \( d \) = Cavern diameter
- \( b \) = Pillar width
- \( a \) = Distance to the edge of salt dome

Operating parameters
- \( P_{\text{min}} \) = Minimum permissible operating pressure
- \( P_{\text{max}} \) = Maximum permissible operating pressure

Source: Lux, 1984
Rock Mechanics

Boundary Conditions:
- Working Gas Volume
- Storage Concept
- Withdrawal / Filling Rates

Rock Mechanical Laboratory Tests
↓
Rock Mechanical Calculations
↓
Assessment (Stability, Usability)
↓
Rock Mechanical Layout (Optimisation)
Drilling

Basis: Geological Planning

- Casing Schemes
- Facility Specifications
- Sampler Service
- Coring Programme
- Mud
- Sampling
- Cementations

Directional Vertical Drilling

Deviated Drilling

\[ f(\text{space}; \text{equipment}; \text{risk}; \text{cost}) \]
Solution Mining

Leaching Method

Leaching Plan (e.g. multistep leaching)

Leaching Steps

Leaching Simulation

Leaching Concept
Leaching Plant

- Number of Simultaneously Leached Caverns
- Fresh Water Supply
- Brine Disposal (additional use)
- Operation (automatic; manual)
- Type of Blanket (oil; N₂)
- Structural & Civil Engineering
- C&I

Comparison of Leaching Rate and Time
Leaching Process

Monitoring of Leaching Process
- Physical Values
- Chemical Values
- Blanket Interface

Sonar Surveys

Work Over Activities

 Modiﬁcation of Leaching Process

(CavView, Socon, Germany)
Completion and Gas First Fill

Completion = Conversion from Leaching to Gas Operation

- Removing of Leaching Strings
- Installation of Gas Storage Equipment (Production Tubing; Gas Wellhead)
- Well Integrity Test
- String for Brine Displacement
- Sonar Survey
- Subsurface Safety Components
Completion Alternatives (example)

with or without Production String

with or without Production String

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Surface Facilities / Gas Storage Plant

Crucial Parameter: Operation Mode

- Time Pattern
- Injection / Withdrawal Rates

Injection / Withdrawal with / without Compressor

- Reciprocating Compr.
- Centrifugal Compr.

Dehydration

Technical + Economical Optimisation
Authority Engineering

State Concession for Extraction

Approval Procedure
- Regional Planning Procedure
- Nature Conservation
- Operating Plans
- Application for Leaching
Examples for Authority Engineering

- Customer
  - Mining Authority
    - Authority A e.g. (Civil Eng.)
    - Authority B e.g. (Water Disp.)
    - Authority C e.g. (Environment)
  - Permission

- Customer
  - Authority A e.g. (Civil Eng.)
  - Authority B e.g. (Water Disp.)
  - Authority C e.g. (Environment)
  - Authority D e.g. (Mining)
  - Permission
### Time Schedule

#### Planning and Construction of Storage Facility (4 Caverns)

<table>
<thead>
<tr>
<th>Time Line</th>
<th>Year 1</th>
<th>Year 2</th>
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Apportioning of Costs

- Exploration
- Salt Exploitation Rights
- Water Procurement / Brine Disposal
- Estate costs
- Drilling / Completion
- Leaching Plant
- Leaching Procedure
- Gas First Fill
- Gas Plant
- Cushion Gas

Proportion on total amount

0% 5% 10% 15% 20% 25% 30% 35%