European Mine Rescue
-
Research Results of the I²Mine Project

Dipl.-Wirt.-Ing. Felix Lehnen

RWTH Aachen University,
Institute of Mining Engineering I
I²Mine Project

- European Mining at Great Depths
- Challenge of Long-Lasting Entrapments

Excerpt of Results

- European Mine Rescue Platform
- Location and Drilling Technology Assessments
- Rescue Chamber Design

Outlook

- Mine Rescue Management
- Publications
The I²Mine Project

Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future

- European Mining at Great Depths
- 4 Year Project, 26 Million Euro Budget
- 27 Partners from 10 EU-Countries, e.g.: Sandvik, RWTH Aachen University, LKAB, A!, Dräger, KGHM, K+S, Boliden, DMT, Caterpillar, Tomra Sorting Solutions, Kompania Węglowa S.A., ABB
Work Package 6: “Health and safety and environmental aspects in future deep mining”

Task 6.6: “Deep Mine Rescue”

Scenario: „Miners trapped underground“

Entrapments > 3 Days:
Great depths can lead to long-lasting missions and further challenges for mine rescue teams.

Long duration leads to new dimensions for mine rescue.
European Mine Rescue today

- Private vs. Governmental Structures
- Company-owned Mine Rescue Teams vs. civil Fire-Fighters
- Bilateral Cooperation instead of international Networks
- European Directives vs. National Mining Laws and Standards

Potentials

- more collaborative Approach
- European Mine Rescue Platform
**Build-Up of a web-based European Mine Rescue Platform (EMRP)**

- Database of Capacities, Experts and Equipment
- Currently on the Agenda of the EU Standing Working Party on Mine Safety, Luxemburg.
- Increase Preparedness and European Standards in H&S and Mine Rescue

<table>
<thead>
<tr>
<th>Country</th>
<th># underground mines</th>
<th># central mine rescue stations</th>
<th># mine rescue teams</th>
<th># mine rescue personnel</th>
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</thead>
<tbody>
<tr>
<td>Germany</td>
<td>20</td>
<td>6</td>
<td>16</td>
<td>n/a</td>
</tr>
<tr>
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<td>15</td>
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<td>Ireland</td>
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<td>2</td>
<td>12</td>
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<td>Spain</td>
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<td>4</td>
<td>8</td>
<td>1000</td>
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<td>4</td>
<td>8</td>
<td>6150</td>
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<td>4</td>
<td>12</td>
<td>600</td>
</tr>
<tr>
<td>Russia</td>
<td>22</td>
<td>4</td>
<td>86</td>
<td>430</td>
</tr>
</tbody>
</table>
EMRP Prototype

Manage mines
Here you can manage the saved mine data and handle submitted changes from registered users.

Mittersill
Wolfram Bergbau und Hütten AG
Berga, A-6543 St. Martin i.S.
Office: office@wolfram.at
+43/6470770

Mine name
Address: Oberreben 54, 5730 Austria
Latitude: 47.22509
Longitude: 12.48907

European country
Austria

Rescue Service Management
Here you can manage rescue services in EMRP Database.

Rescue services in database

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Operator</th>
<th>Related mine</th>
<th>Rescue equipment and details</th>
<th>Verified by</th>
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</thead>
<tbody>
<tr>
<td>Hauptsache Oberreben</td>
<td>Berliner Strasse 5, D-39670 Clausthal-Zellerfeld</td>
<td>Wolfram Bergbau und Hütten AG</td>
<td>Show details</td>
<td>Method: In-Situ Bandmann</td>
<td>Method: In-Situ Bandmann</td>
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<td>D-82382 Holzheim</td>
<td>Wolfram Bergbau und Hütten AG</td>
<td>Show details</td>
<td>Method: In-Situ Bandmann</td>
<td>Method: In-Situ Bandmann</td>
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<tr>
<td>Hauptsache Oberreben</td>
<td>Fiderennersreut 62, D-04307 Leipzig</td>
<td>Wolfram Bergbau und Hütten AG</td>
<td>Show details</td>
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<td>Wolfram Bergbau und Hütten AG</td>
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</table>

Auguste-Victoria
RAG Deutsche Steinkohle
Germany

Contact information:
RAG Deutsche Steinkohle
Shamrockring 1, 44255 Herne
Phone: +49/23315-2596
E-Mail: christof.beike@rag.de

Commodities: Coal
Mining method: Rescue Service n/a
Locating Trapped Miners

- Tracking
  - RFID, ...

- Seismic Locating
  - Geophones, ...

- Communication
  - Trough-the-Earth, ...
Locating Trapped Miners

TOP Locating

Technical
- Preventive Tracking
- Seismic Location
- TTE Communication
- Drilling

Organizational
- Shift Plans
- Tracking Data

Personal
- Interview Survivors and Shift Planners
Drilling Technology

- **Rescue Drilling from Surface as the Worst-Case Scenario**

- **1st Step: Pilot Drill Hole**
  - Small diameter (< 10 cm) to locate, contact and supply the trapped Miners
  - Life-critical drilling time, Transfer of Chile (2010; 700 m) to 2000 m: 49 Days

- **2nd Step: Rescue Drill Hole**
  - Large Diameter (> 40 cm) for the actual Rescue of the trapped Miners
  - Mission-defining drilling time, Transfer of Chile: another 97 Days

- **Great Depths**
  - Drilling deeper than 2000 m is technically feasible.
  - Drilling is life-critical and should be top Priority during the Rescue Mission.
  - Redundant and parallel Strategies are highly recommended.
Rescue Chamber Design

- 4-Month Design Study at Lulea University, Sweden
  - Mobile, slim Chamber with Service Cart
  - Hammocks and removable Seats

- Synthesis of Isolation Studies
  - Valuable Know-How in Space Flight, Antarctic Missions, …
  - Psychological Considerations
  - Habitable Furniture
  - Food and Medical Rations

- Requirements in Mining
  - Stability during regular Blasting
  - Max. 4 Persons in Road-Heading
### Example: Air Supply

**Calculated Demand**
- High Stress, Low Motion: 0.75 m³ of Air per Person and Hour
- 4 Miners trapped for 30 Days: 2,160 m³ of Air in total

**Ambient Air available**
- Rockfall or Inundation Scenario: no hazardous Gases
- Typical Cross-Section of 5x5 m
- 87 m of open Drift would be sufficient.

**Worse Case Scenario**
- Insufficient Fresh Air
- 86,400 Liters of pure Oxygen needed
- 9x 50-Liter-Bottles of pure Oxygen @ 200 bar
Example: Nutrition

- **Demand of Water**
  - 2 Liters per Miner and Day
  - 240 Liters of Water in total

- **Alternative Storage**
  - e.g. between 2-Layer Walls
  - 5 cm in a 1x2x3 m Chamber: 1,000 Liters

- **Demand of Food**
  - 1,800 kCal per Miner and Day → 216,000 kCal

- **Military Solution**
  - “First Strike Ration” (FSR™)
  - Each FSR: 2,900 kCal, 1.1 kg, 3.1 Liters
  - Demand: 75 FSR, 1,000 €, 2-Year Shelf-Life
Felix Lehnen: European Mine Rescue – Research Results of the I²Mine Project

Outlook

■ Best Practice Guide

- Implementation of all prior Findings
- Preventive Measures and Emergency Technologies
- Preparedness by European Cooperation
- Implementation of Disaster Management Principles

■ Ph.D. Thesis

- Scenario Definition
- Database of Mine Rescue Missions and Statistical Evaluation
- Qualitative Case Study Research
- Transfer of Disaster Management Principles
- Mine Rescue Management Concept
Thank you!


