
Technical equipment and operation for a refuge room in: Shaft Konrad Mine

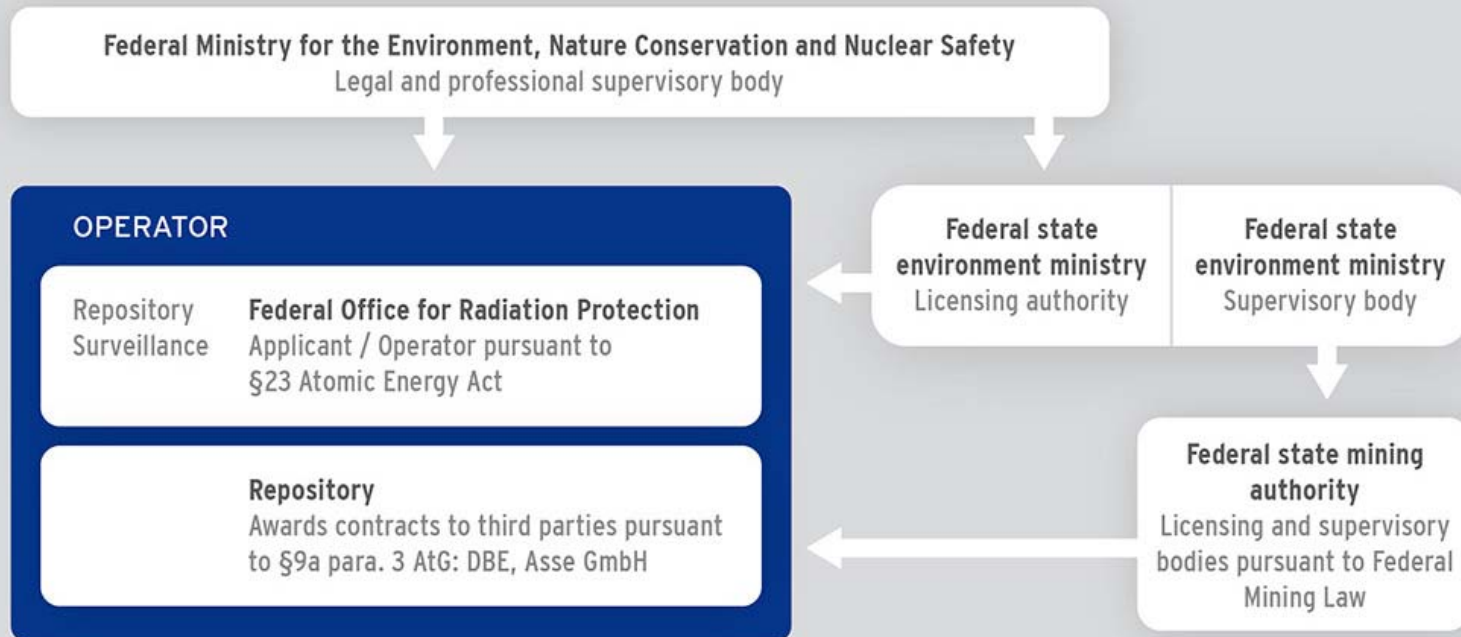


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Repository for nuclear waste

Protagonists and responsibilities

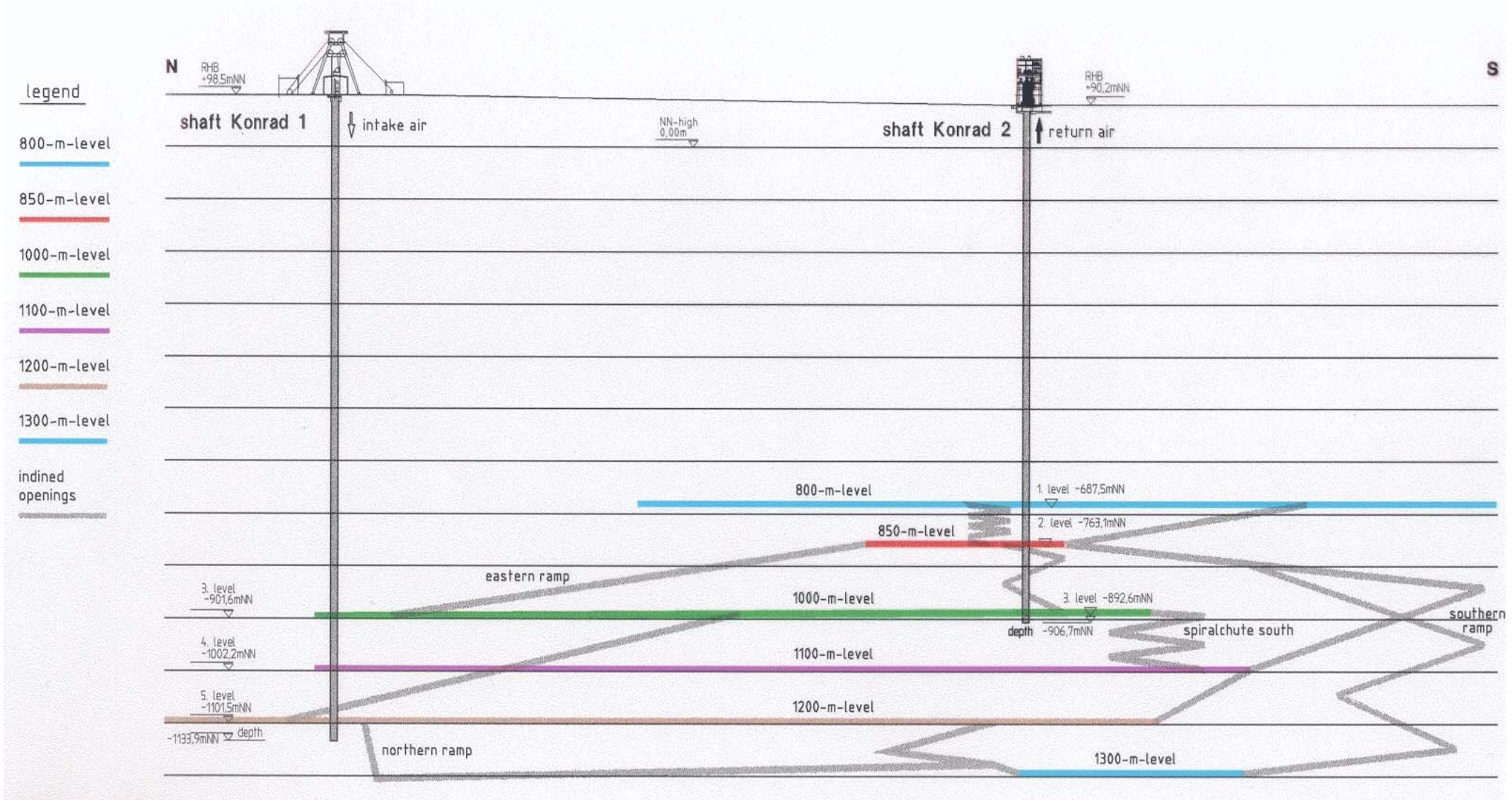
The overall responsibility for the construction and operation of the Konrad repository is with the Federal Office for Radiation Protection.



In 1984, the federal government concluded an agreement with the German Company for the Construction and Operation of Repositories for Waste (DBE) and commissioned the DBE with the “planning and construction of federal facilities for the long-term storage and disposal of radioactive waste”.

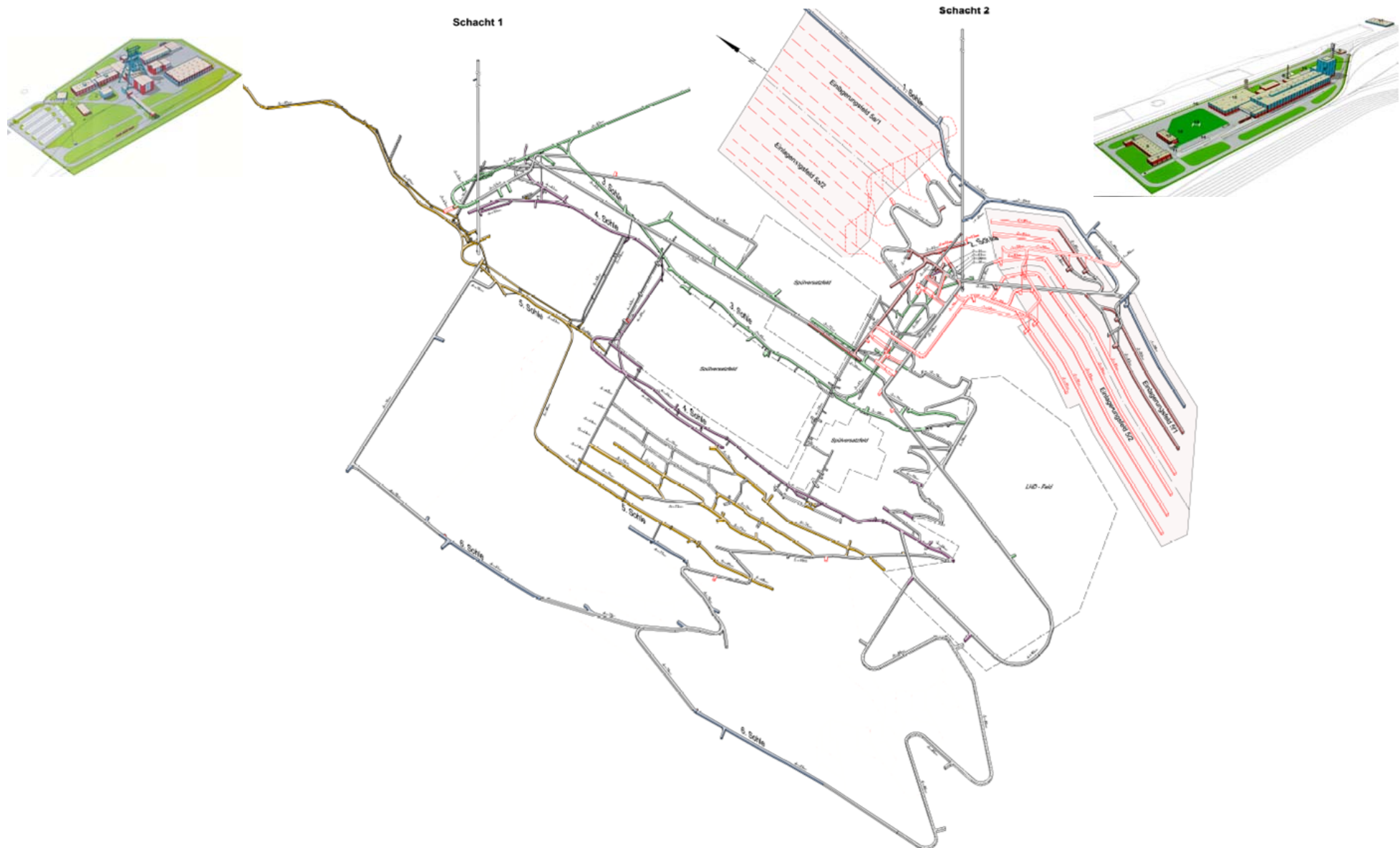
Quelle: http://www.bfs.de/Konrad/EN/themen/endlager/Verantwortlichkeiten/verantwortlichkeiten_node.html

Mine layout: cross section through the mine



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Mine layout: underground openings

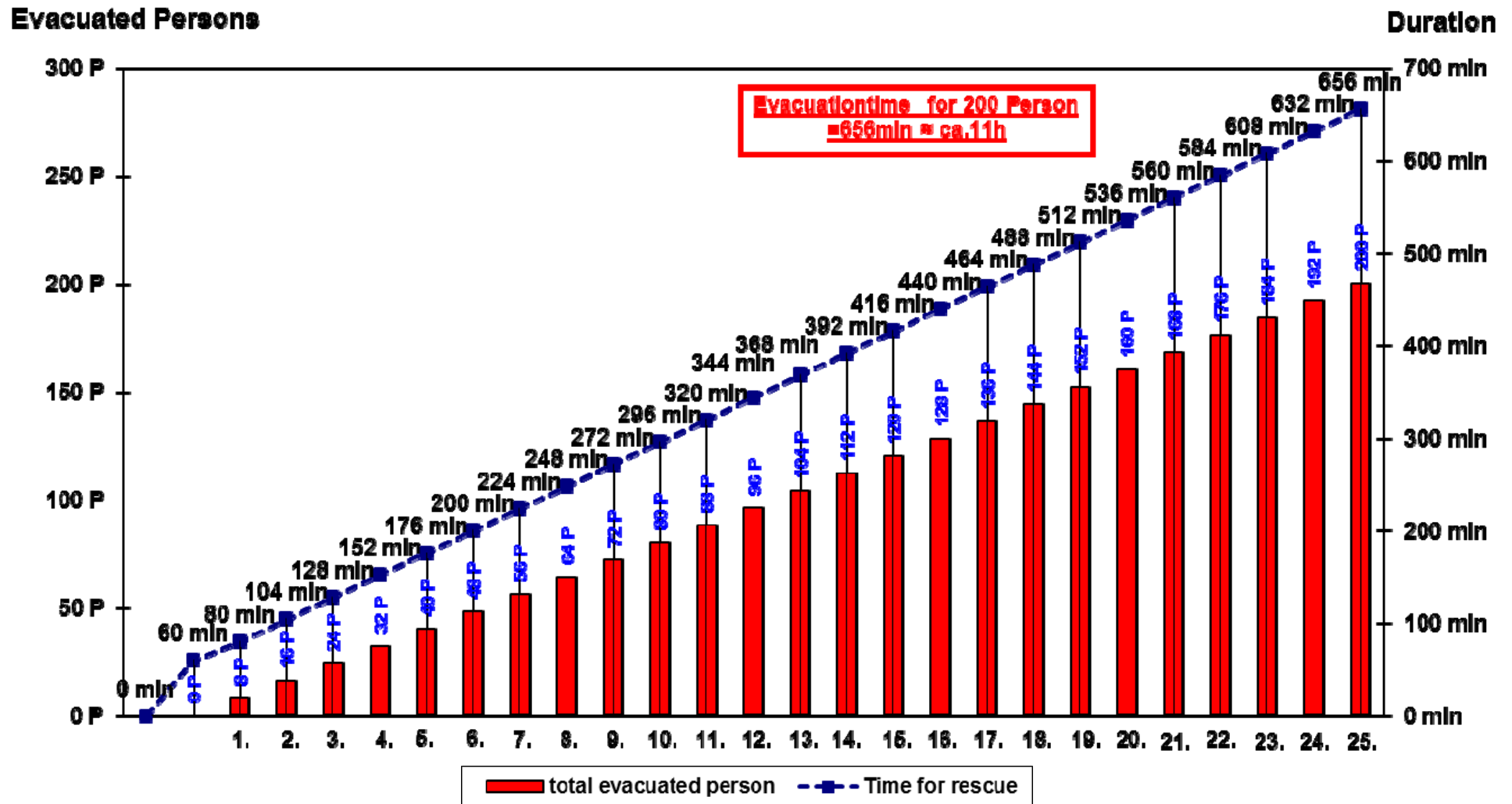


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The need for an underground refuge room

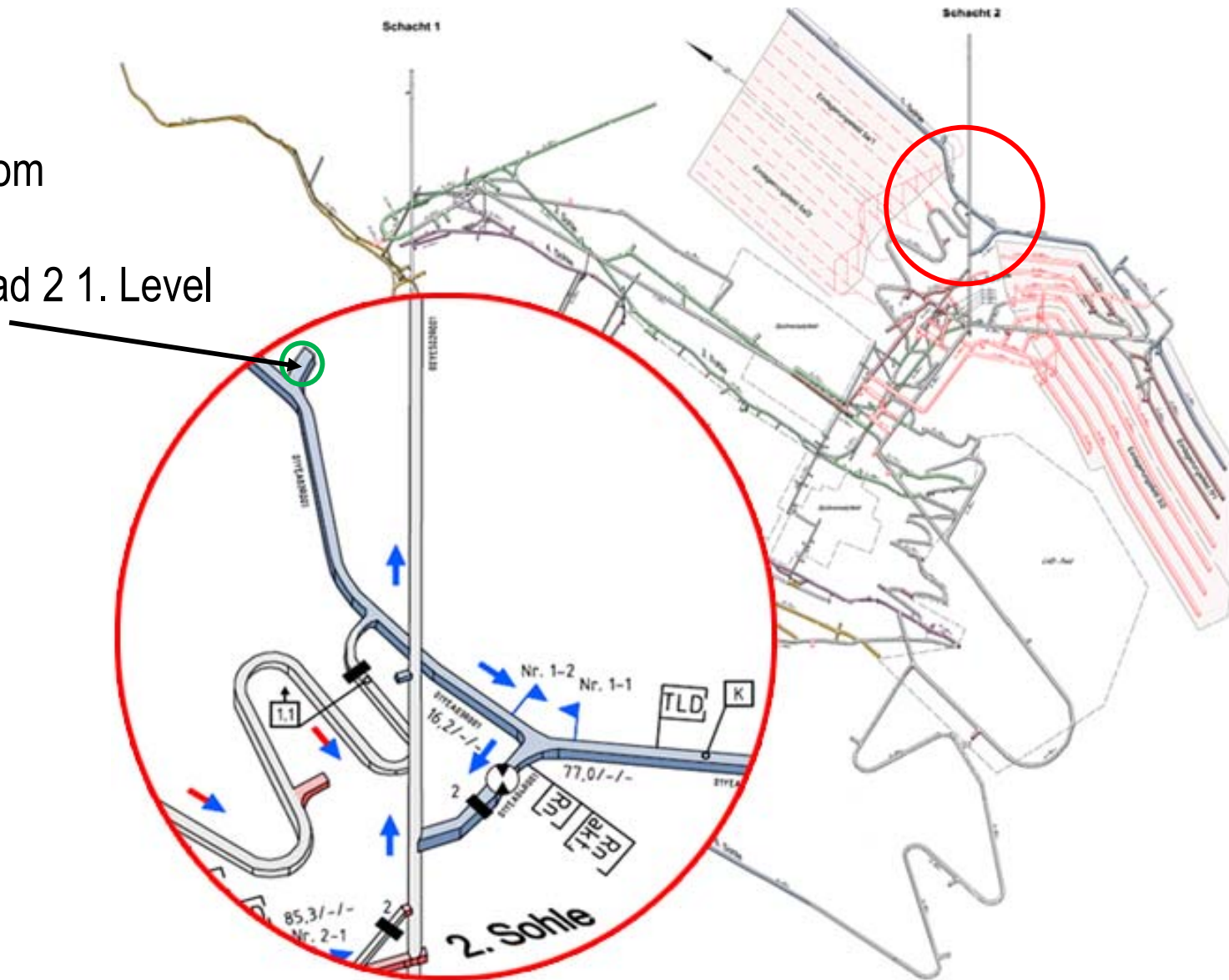
- Preparation of an evacuation concept during the reconstruction of the shafts and the rebuilding of the shaft house.
- Shaft Konrad 1 is still equipped with wooden cage guides.
- A fire, in the shaft, or the shaft house whilst construction work is in process, is the main threat.
- A quick evacuation via shaft Konrad 2 is not possible.
- During the reconstruction of shaft Konrad 2, a two-level emergency cage for 8 person is in use: evacuation can only take place from the first level to the surface.
- For reconstruction work in the shaft, the two-level emergency cage has to be replaced by a bucket or transport equipment.
- The change in the operation mode takes about 60 minutes. Then the emergency cage is ready for evacuation from the first level.

Time needed for evacuation



Location of the underground refuge room

Refuge Room
close to
Shaft Konrad 2 1. Level



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Underground refuge room - requirements

Requirements:

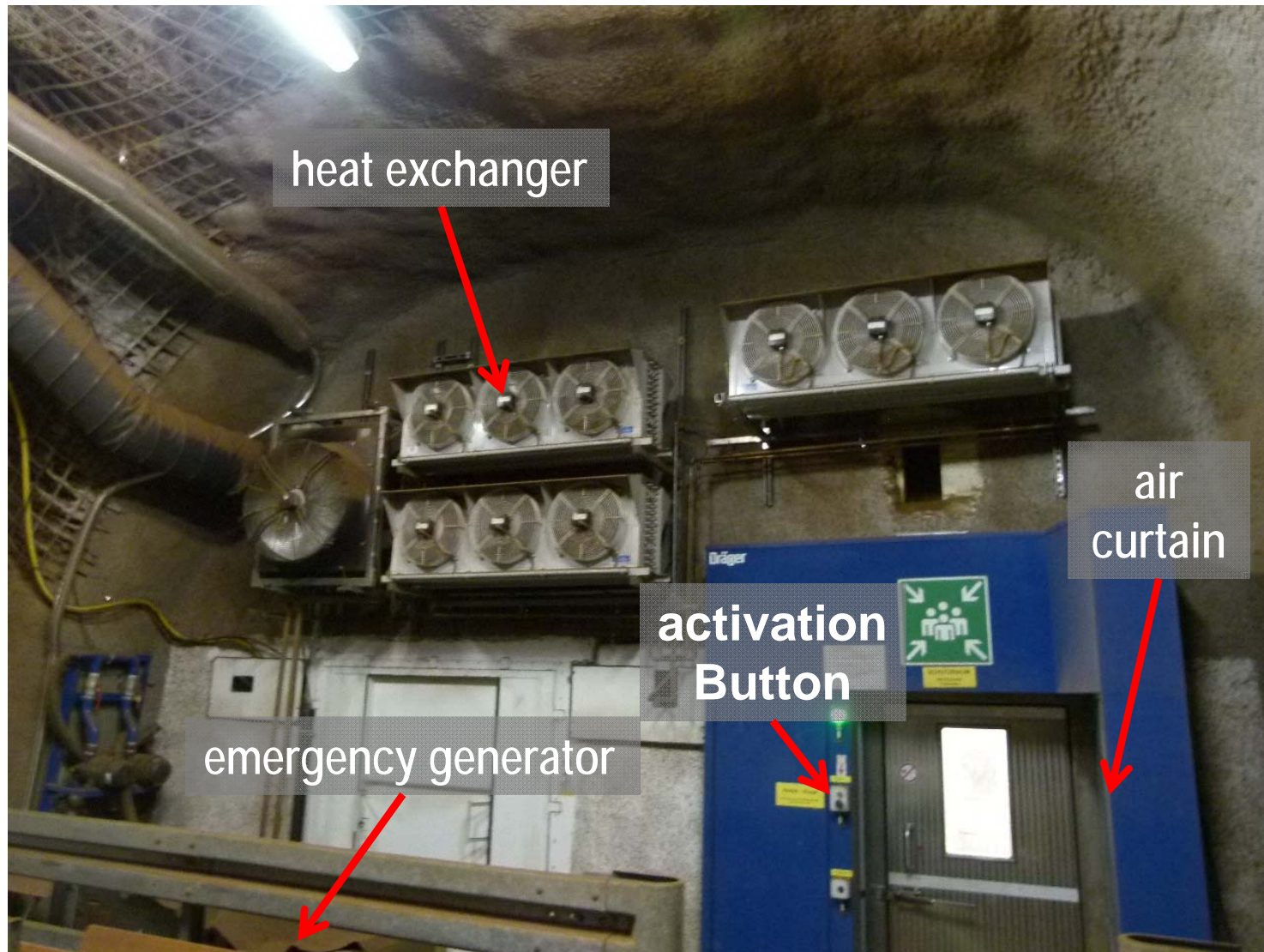
- max. number of persons: 200 Person
- length / width / height: 25 m / 6 m / 5,5 m
- Duration of stay: minimum 11 hours
- Distance to Shaft Konrad 2: ca. 380 m
- almost airtight walling
- Entrance via a lock chamber
- permanent overpressure (200 PA)
- gas detector for carbon dioxide, oxygen and carbon monoxide
- instant air regeneration: Oxygen supply, CO2 absorption
- two way independent power supply
- Cooling of air inside the room by air-conditioning unit
- Interior facilities specification: seat bench, first aid equipment, toilet etc.
- 'spare miners self rescuers' for escaping via Shaft Konrad 2

Underground refuge room

technical components:

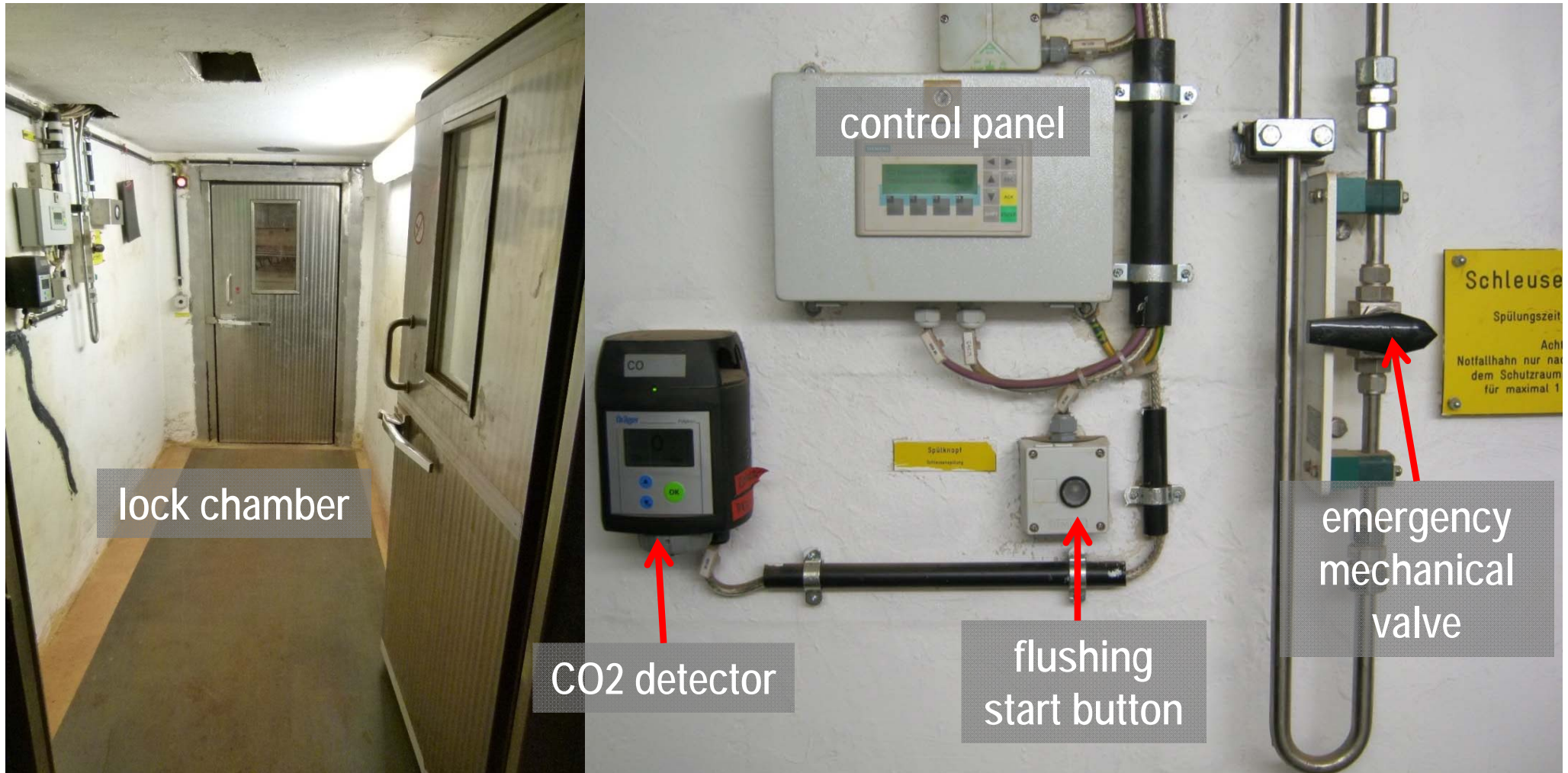
- lock chamber: access control and airlock with air flushing
- air curtain equipment at the outward door
- positive pressure of roughly 200 PA, made up by compressed air bottles (stored 1.170.000 litre)
- air regeneration: 30.000l oxygen supply, CO₂ absorption through 3 units
- air conditioning
- independent power supply via emergency generator and battery backup
- gas detector for carbon dioxide, carbon monoxide and oxygen
- Seating
- Lighting / emergency lighting
- Chemical toilets
- Emergency provisions: drinking water
- first aid equipment
- communication equipment (telephone, wireless equipment)

Underground refuge room – outside view - total



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Underground refuge room - the lock chamber



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Underground refuge room – operation mode

The 3 types of business in case of an emergency

- 1. Refuge Room in main operation:
 - normal power supply via public network
 - all device run normal
 - positive pressure and air supply carried out by mechanical operation
- 2. Refuge Room runs by emergency generator:
 - black-out of normal power supply and emergency generator in operation
 - all device run normal
 - positive pressure and air supply carried out by mechanical gear
- 3. Refuge Room runs by battery backup:
 - black-out of normal power supply and emergency generator
 - life saving devices: air regeneration, gas detection, communication opperating
 - air conditioning and air curtain switch off
 - positive pressure and air supply carried out by mechanical gear

Underground refuge room – inside view



CO2 absorber
station

miners
selfrescuer
depot



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Underground refuge room – Compressed air

Compressed air in bottles

The controlled blow out of compressed air via switch panel has two functions:

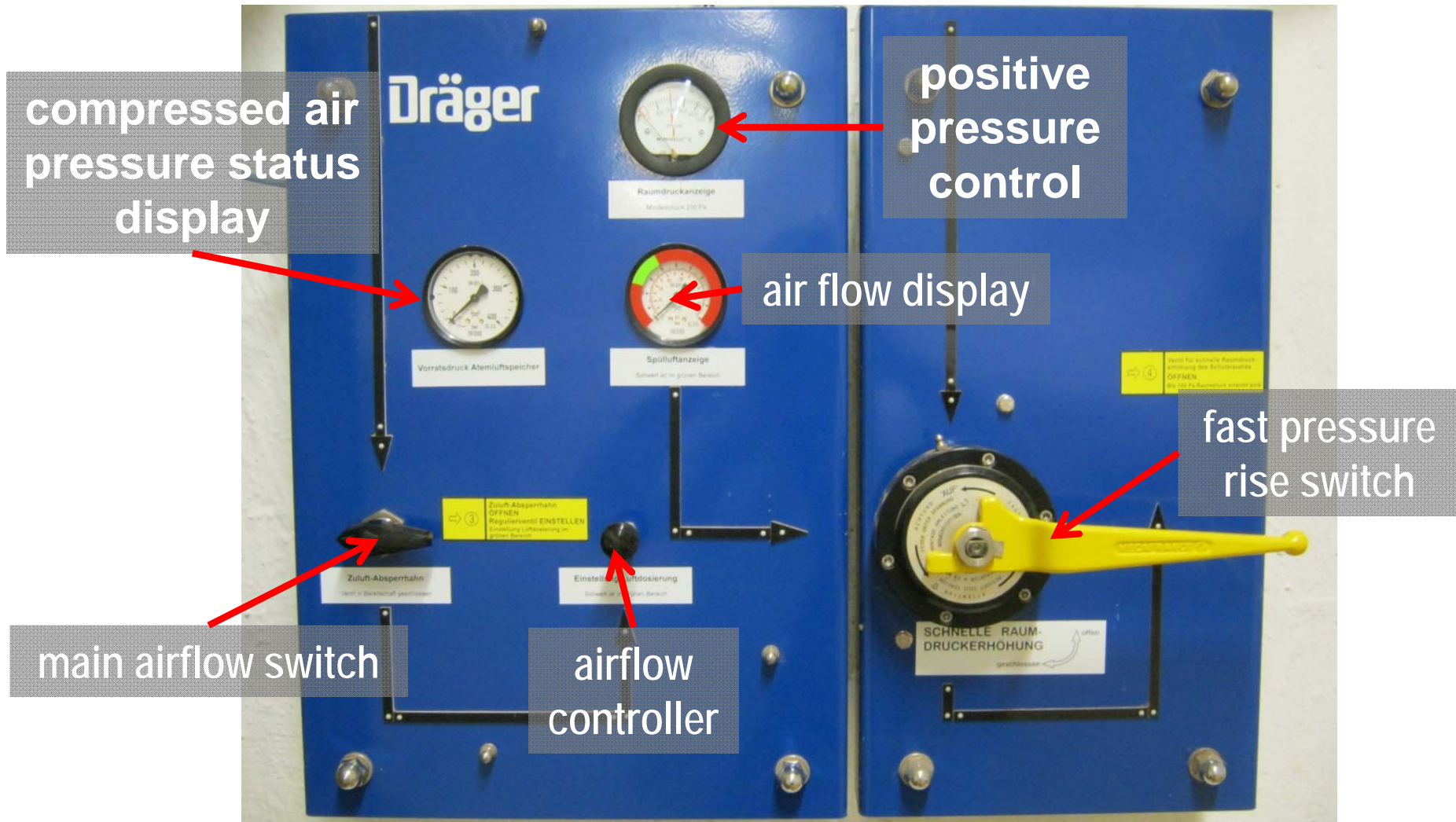
1. to supply people with oxygen.
2. to produce positive pressure inside the refuge room compare to the outside

Nearly 50 % of the compressed air will be used for flushing the lock chamber. This will keep contamination, caused by smoke, CO or CO₂, out of the refuge room.



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Underground refuge room – air control panel



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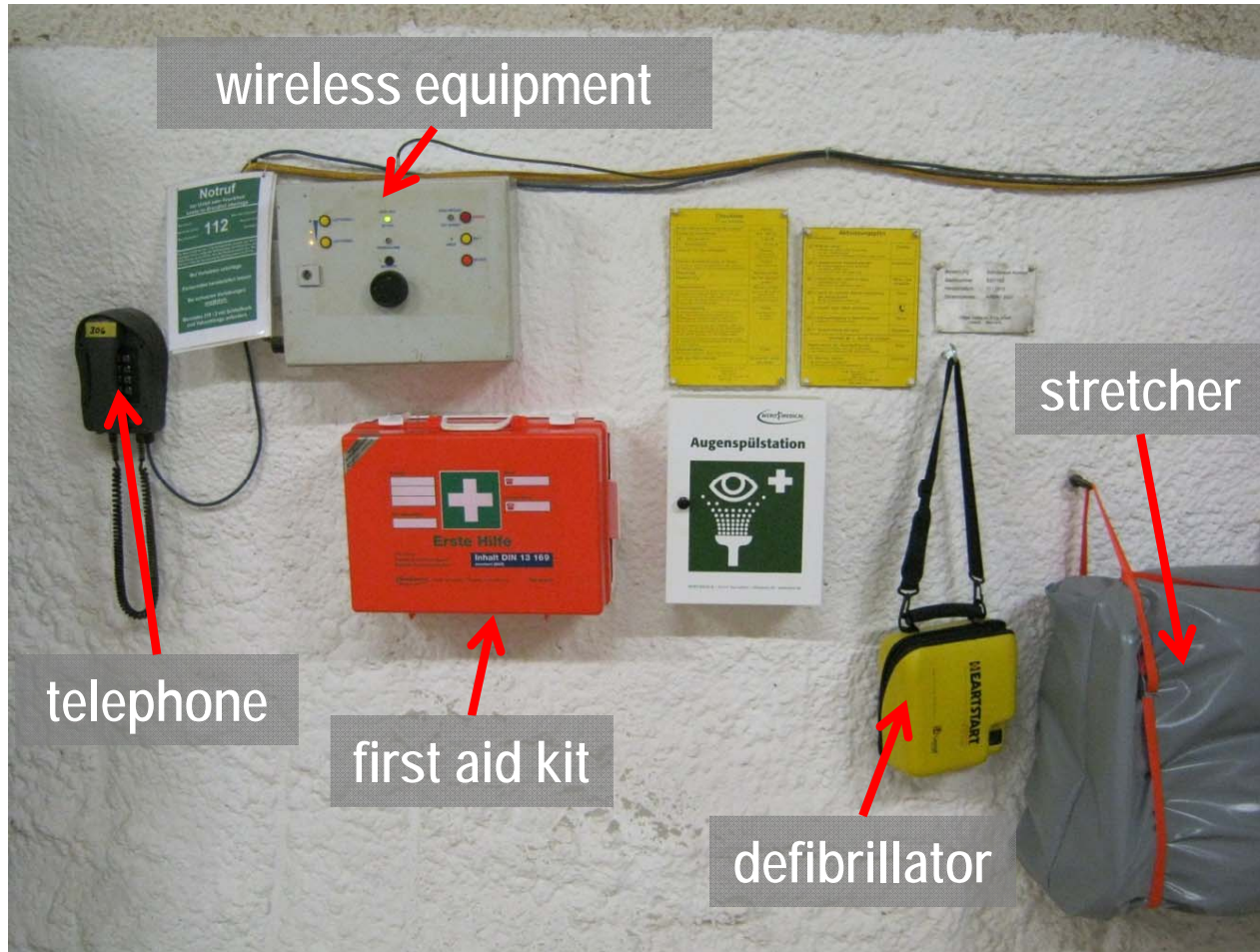
Underground refuge room – air quality

Measurement of harmful gas

- The oxygen in the refuge room is necessary for the people to survive. To check the air quality a measurement system is provided.
- Carbon monoxide detectors are installed in the lock chamber and the technicroom.
- The refuge room is equipped with a detector for carbon dioxide and oxygen.
- The detector in the lock chamber controls the use of it. If a red light is shown, first flushing of the lock chamber has to be done. After flushing is over, the door to the refuge room can be opened. To secure the unwanted operation of the doors, a magnetic lock is installed.
- The results of the measurement are shown on the control panel. Signal lights (green, yellow, red) indicate the status of the air.

Sensortyp	Pre-alarm (yellow light)	Alarm (red light)
CO	≥ 15 ppm	≥ 30 ppm
CO ₂	≥ 2.000 ppm	≥ 5.000 ppm
O ₂	$< 20,4 \%$ or $> 21,4 \%$	$< 19,0 \%$ or $> 23,0 \%$

Underground refuge room – Communication & first aid



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Underground refuge room – Process of evacuation

Evacuation of the refuge room:

- The change to the emergency cage has to be done using breathing protection.
- The mine rescue brigade is in charge and starts the evacuation via shaft Konrad 2.
- The rescue brigade contacts the refuge room.
- 8 person equip themselves with new 'miners self rescuers' and leaving the refuge room.
- The rescue brigade accompanies them to no. 2 shaft at 1. level.
- When they have reached the surface, the 'miners self rescuers' can be taken off.

Thank you for your attention



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