

Deep Within the Mountain

Safer rooms underground and innovative respiratory protection equipment offer state-of-the-art solutions for mining and tunnel construction. They form the basis of the latest **RESCUE CONCEPTS** worldwide as emergency plans for mines and construction sites hundreds of meters down grow increasingly stringent.

Intensive operations underground require maximum safety. That applies equally to the Konrad shaft in Salzgitter, Germany, and the Olympic Dam Mine on the other side of the globe in Australia. Yet the two facilities are vastly different in terms of their use. In Germany, the mine is being converted into a permanent repository for low- and intermediate-level radioactive wastes, whereas in Australia's largest underground mine, new deposits are being prepared for the extraction of ores. What connects the two, on the other hand, is their safety equipment, which includes rescue chambers and refuge chambers on a very high level by international comparison.

Reports about mine accidents illustrate just how important it is to continue to improve underground safety in many countries. And this situation is indeed changing for the better. While mines and transportation tunnels have steadily gotten bigger in recent years, the safety requirements for mining and tunnel construction have become more stringent worldwide. "And the lawmakers are imposing increasingly stringent standards," says Norbert Poch, Head of the Breathing Air Supply Systems unit at Dräger. Innovative protective and rescue equipment for the mining industry was therefore the focus of the International Mines Rescue Conference held in the Czech Republic in fall of 2009 (see also interview, p. 17).

Customized rescue concepts

Because of the different conditions underground, safe rescue concepts rely on customized solutions. Among their most



Konrad shaft or Olympic Dam—the risks underground are similar worldwide.



This self-contained rescue chamber protects against smoke and particles.



The rescue chamber is gastight so that occupants can breathe freely.

important components are respiratory protection equipment for self-rescue and safer rooms such as rescue chambers and refuge chambers. “The different variants of the two systems are complementary,” says Poch. He also points out that “today’s rescue concepts include a combination of refuge chambers, rescue chambers, and personal respiratory protection equipment.”

Escape to the surface

Refuge chambers and rescue chambers offer very good odds of survival, even in the event of explosions, fires, or the release of hazardous gases. Refuge chambers are stationary and are generally created by separating a dead-end gallery from the mine using walls and an air-lock. A large number of people can wait in these areas for an extended period of time to be rescued by external rescue crews. Rescue chambers, on the other hand, are usually mobile containers and intended as an intermediate stop during a self-rescue. “Self-rescue by escaping to the surface should be the objective whenever possible,” says Dietmar Diercks, a product specialist at Dräger.

Innovative respiratory protection technology is showing the way forward here. Dräger’s “Charge Air” (in Australia: “Quick Fill Stations”) is a system with breathing air refilling stations for self-rescue over greater distances. Charge Air is currently used primarily in coal mines where escape from the mine (self-rescue) has absolute priority over refuge chamber concepts, due to the problems of firedamp and fire. Charge >



ST-3278-2007

Rescue chambers can be flexibly configured and can provide protection for up to 20 people for several days.



D-16503-2009

Charge air enables the rapid refilling of compressed air respirators for improved safety.

> Air makes it possible to rapidly refill compressed air respirators. “A nine-liter cylinder can be refilled from 50 to 300 bars in 45 to 70 seconds without any interruption of the breathing air supply,” explains Stefan Reiling of Dräger, who supports the system in Australia. That corresponds to a 60-minute supply of breathing air. Refilling is performed using a purely pneumatically controlled sequential cascade system that makes more efficient use of the available air than direct filling. Standard Charge Air units from Dräger are suitable for filling either 20 or 40 breathing air cylinders. Longer evacuation routes are easy to handle with Charge Air than with oxygen self-rescuers, and in addition the breathing air is more pleasant. The Oaky Creek Coal mine in Queensland, Australia, currently has more than 80 systems in use, making it the largest customer for this technology.

The largest active underground mine in Australia is located in the middle of the outback, some 600 kilometers north of Adelaide. “Olympic Dam” is a world unto itself. Several hundred miners are under way in its passages every day, fully decked out with respiratory protection masks on their belts and mine lamps on their helmets. New tunnels are opened every day, each one looking exactly like the others. A tangled maze of roads and tunnels several hundred kilometers long runs through the granite.

Up to 36 hours of protection

Dräger will provide the mine with its new refuge chamber, in which up to 100 people can find shelter and safety for up to 36 hours. A slight positive pressure relative to the atmosphere in the mine, an air curtain unit, and an airlock are intended to keep hazardous gases out. The regeneration unit is responsible for sep-

arating carbon dioxide (CO₂) from the breathing air in the climate-controlled refuge chamber and adds oxygen accordingly. Gas detectors continuously monitor the airlock for hazardous gases in the airlock and also monitor the concentrations of oxygen, carbon dioxide, and carbon monoxide in the refuge chamber.

A refuge chamber will also be among the safety features of the Konrad shaft, where the extraction of ore was discontinued back in 1976. More than three decades later, work is currently under way to upgrade the mine in Salzgitter for its future role as a final repository for radioactive wastes that develop insignificant amounts of heat. Among the first steps in the conversion process is the installation of rescue chambers and also a refuge chamber. These chambers serve as places to which miners can retreat, primarily during the conversion phase. “The risks during tunneling and backfilling are hardly any different from those you find in an active ore mine,” says Dr. Thorsten Rebehn from the German Company for the Construction and Operation of Waste Repositories (DBE). The conversion phase is scheduled to last from 2010 to 2014.

The refuge chamber, which can hold up to 150 people, was designed to be used in a worst-case scenario involving a fire in the Konrad 1 shaft, which was sunk back in 1957. This is the “downcast shaft,” through which fresh air flows into the mine, and that is the reason it is the preferred escape route in case of an evacuation. However, if a fire was to break out in the downcast shaft, the entire mine could

Guidelines and ordinances

Throughout the world, there are various guidelines and ordinances that regulate the use of rescue and escape chambers. The applicable regulations in Germany are contained in the General Mining Ordinance for Underground Operations, Open-cast Mining and Salt Mines (ABVO) and the German Tunneling Committee’s (DAUB) Guidelines for Planning and Implementing Safety and Protective Concepts at Underground Construction Sites. The corresponding international regulations include the Final Rule (2008) for Refuge Alternatives for Underground Coal Mines of the US Mine Safety & Health Administration (MSHA), as well as the Queensland Mining and Quarrying Safety and Health Regulation 2001 and the Refuge Chambers in Underground Metalliferous Mines regulation of the Department of Industry and Resources of Western Australia.

be filled with hazardous gases, and the people in the mine would have to be evacuated through the Konrad 2 shaft.

In Germany, rescue chambers are also created directly in the mine when the storage chambers are constructed, in line with the requirements of the General Mining Ordinance for Underground Operations, Open-cast Mining and Salt Mines (ABVO, see box on p. 16). According to the ordinance, tunnels that are more than 400 meters long require rescue chambers in cases where there are no additional connections to other parts of the mine and where miners could therefore have their escape route cut off by a fire. “Only the miners in the immediate vicinity would flee into these chambers,” explains Ingo Sandmann, who is responsible for the North Region at Dräger in Germany.

Traffic tunnels generate demand

The demand for safety and rescue systems for underground work is steadily increasing. In addition to mines, the construction of long traffic tunnels such as the Gotthard Base Tunnel in the Swiss Alps is generating demand for such systems (see also Dräger Review 96, pages 32 ff.). However, the improvement of safety deep inside mountains is not the only field of application for refuge and rescue chambers. Similar safety and rescue systems are also used to safeguard the personnel working on offshore oil platforms. **Peter Thomas**



D-11066-2010

Mine Rescue in the Czech Republic

Václav Pošta is director of the Central Mine Rescue Station in the Czech Republic. The mines there have been using equipment from Dräger for about 100 years.

What are you most proud of when you look back on your many years of experience as a leader of the Czech mine rescue service?

Mostly of the fact that during the course of 31 years – in other words, the period when I directly supervised accident control – not a single life was lost among the mine rescue personnel.

What were the most important developments for mine safety in the Czech Republic during the last ten years?

First and foremost, we've invested in training and equipment for the personnel. In the last two years alone, about 20 million euros have been spent on shoes, work clothing with reflectors, oxygen self-rescuers, mine lamps, and gas sensors with logging features. In parallel with this, OKD has continued to bring more uniformity to its equipment. For example, every miner works with the same oxygen self-rescuer and gas sensor. And during the last two years, OKD has invested over 330 million more euros in innovations associated with extraction and driving technology. That helps increase safety too.

How is mine rescue service organized for the various OKD mines?

In addition to the Central Mine Rescue Station, there are seven other mine rescue stations. These sites have almost 800 voluntary and professional mine rescue workers who see to the safety of miners and provide rescue services.

Are you only responsible for safety and rescue services in the mines?

Oh, no. Mining is the focus of our work, of course. From the four mines currently active, OKD extracts about 13 million tones of coal per year. But our work extends beyond that. Mine rescue services also play a part in construction projects where mining methods are used, such as when tunnels or underground utility lines are built. We also have agreements with the fire department and the Integrated Rescue System of the Czech Republic for civil deployments: In the event of a fire in a high-rise building, for example, we can provide 300 self-rescuers for the evacuation of victims.

Was the 4th International Mines Rescue Conference (IMRC), which took place in the Czech Republic in the fall of 2009, a flagship project for you?

Definitely. Alongside the development of the mine rescue exhibition in Ostrava, the conference of the International Mines Rescue Body and the 4th International Mines Rescue Conference in 2009 were outstanding events that also help raise awareness of our work among the general public.

The entire interview can be downloaded from the Internet.

Further information online, including:

Product information

www.draeger.com/100/mining