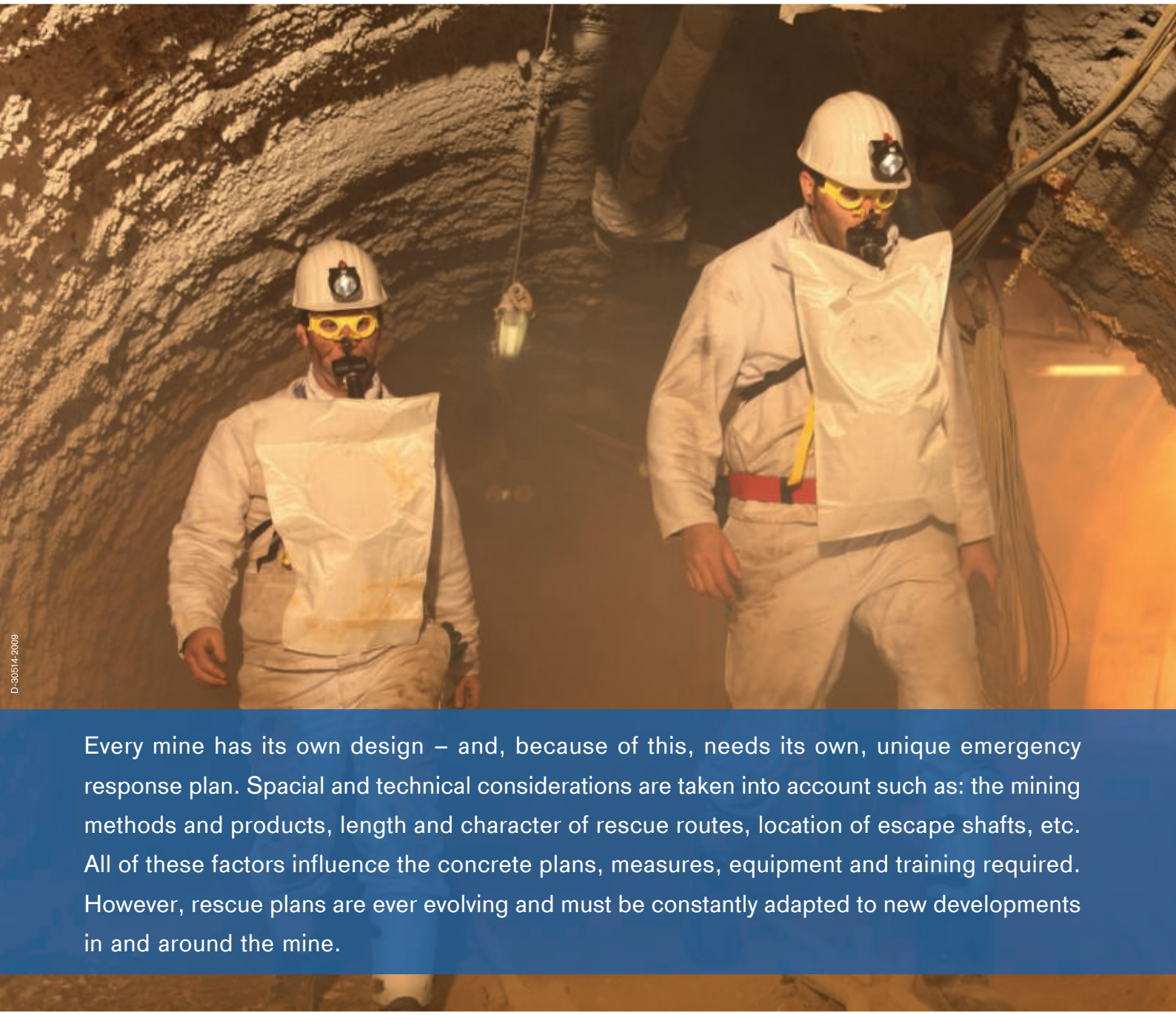
Emergency response planning for safe rescue



D-30514-2009

Every mine has its own design – and, because of this, needs its own, unique emergency response plan. Spacial and technical considerations are taken into account such as: the mining methods and products, length and character of rescue routes, location of escape shafts, etc. All of these factors influence the concrete plans, measures, equipment and training required. However, rescue plans are ever evolving and must be constantly adapted to new developments in and around the mine.

7 steps to an optimum emergency escape concept

Know and understand the situation and conditions — 1

- Mining method/mined product
- Geographical location
- Official and corporate regulations (SOP's)
- Number of miners (incl. contractors) per shift
- Length and condition of rescue routes
- Location of escape shafts and fresh air bases

Take natural hazards into account: — 2

- Temperature/humidity
- Water ingress/flooding
- Dust development
- Mine gas/firedamp

Identify activities involving risks: — 3

- Fueling/handling of hazardous substances (fluids/transportation)
- Storage of explosives
- Blasting

Account for unexpected incidents: — 4

- Ventilation failure
- Gas eruption and leakages
- Sparks/friction

Describe potential hazards/risks: — 5

- Mechanical obstacles
- Oxygen deficiency
- Fire
- Explosion

Perform a risk assessment: — 6

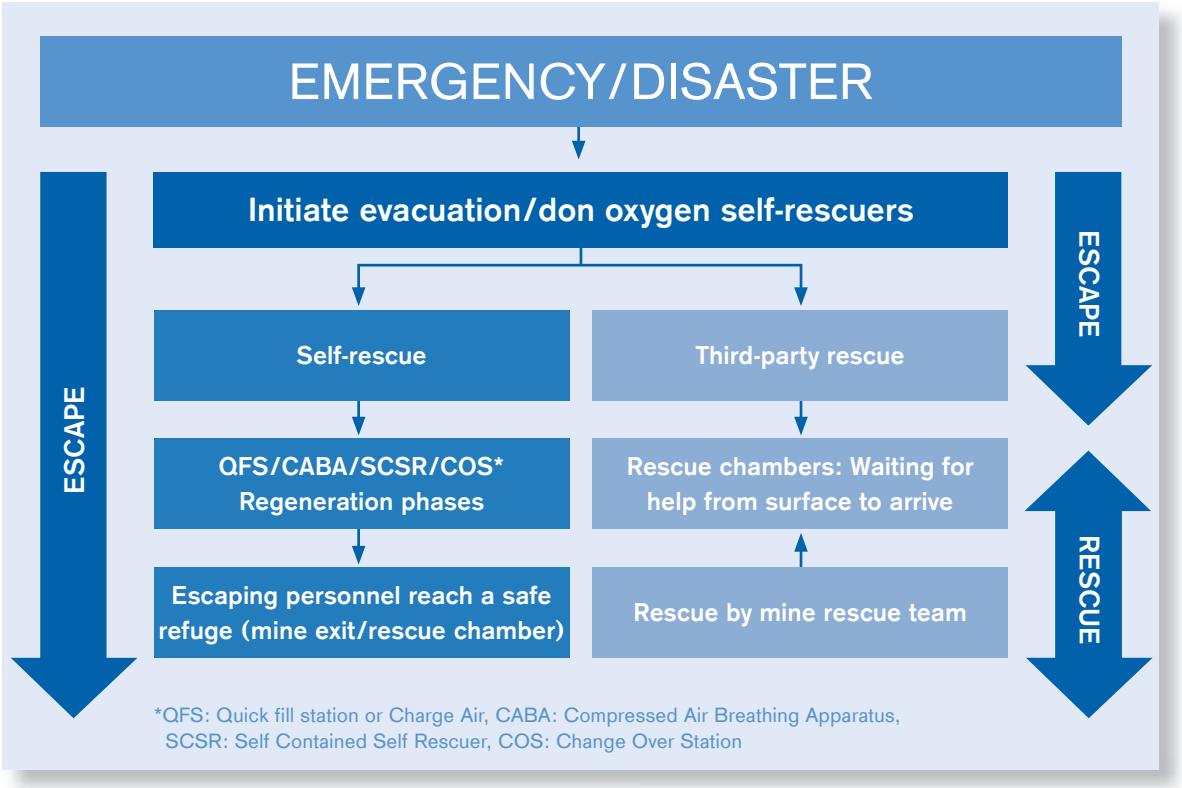
- List, assess and prioritise hazards/risks
- Check risks

Develop an emergency response plan: — 7

- Prepare an emergency plan
- Provide emergency equipment
- Ensure appropriate emergency training

Underground –
self-escape or rescue mission?

If a serious incident occurs underground, the safety manager and the mine foreman must decide within minutes whether self-escape is possible or whether a mines rescue team should be deployed.



DL-8364-2019

Coal mining –
when is self-escape the first choice?

Self-escape means: Victims of incidents are able to get themselves to safety and back to the surface without any additional help. This is almost always the case when emergency escape distances are short enough to be managed on foot. Keeping in mind that the escape route has to be open. So, when an incident occurs, there is no flooding, collapses or rockfalls blocking the way. Read on to find out more about examples of self-escape underground and the appropriate methods and equipment.

IF COAL CATCHES FIRE: IT'S TIME TO GET OUT – FAST!

Depending on the kind of coal being mined and the conditions at the face, a fire can take hold fast, intensify, and burn for a long time. Due to this, self-espace is the usual and best option.

In the following graphics, we show you what self-escape plans look like around the world's coal mines – and how South Africa handles exceptions.

D-114380-2013

Emergency Escape Systems in Underground Mining

Australia

Coal

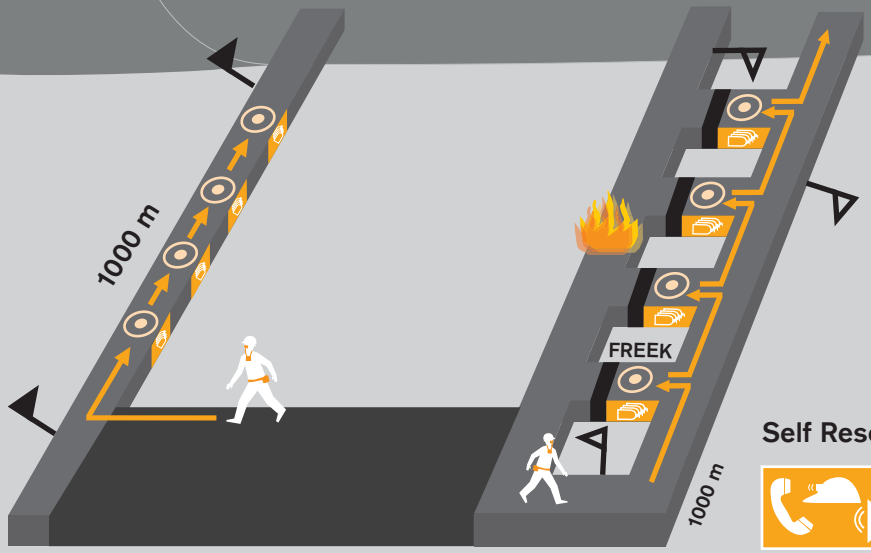
Annual production output:	3.000.000 tons
Number of underground miners:	100
Average depth:	80 m
Average travelling time to workplace:	15 min.

Mine Rescue

- 4 teams (9 each) on site
- 10 mutual aid teams (1 hour)
- CCBA

Fire and Explosion Prevention

- FRAS conveyor belt and automatic fire extinguishing system
- Diesel motor engines with automatic fire extinguishing system
- Oxygen gas monitoring
  Air velocity monitoring, CO, CO_4 monitoring
  Power isolation if CH_4 levels reach 1.25 Vol. %
- Reticulated fire fighting water underground
- Intrinsically safe electronic apparatus



Self Rescue

- Emergency tone over phone Loudspeaker (DAC-System) along conveyors
- Chemical oxygen SCSR (nominal duration 25 min.)
- Marked escapeway
- Lifeline with bobbins
- FREEK (with 25 CABA) plus quick fill stations

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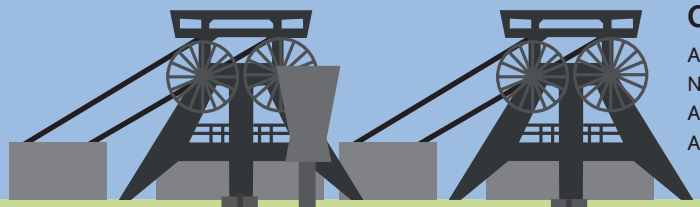
Emergency Escape Systems in Underground Mining

Czech



Coal

Annual production output:	2.000.000 tons
Number of underground miners:	2000
Average depth:	900 m
Average travelling time to workplace:	60 min.

Mine Rescue

19 teams on site

100 mutual aid teams

CCBA

Fire Prevention

FRAS conveyor belt

CO, CH_4 monitoring in all drifts

Water pipes in all drifts

Intrinsically safe electronic apparatus

Water trough

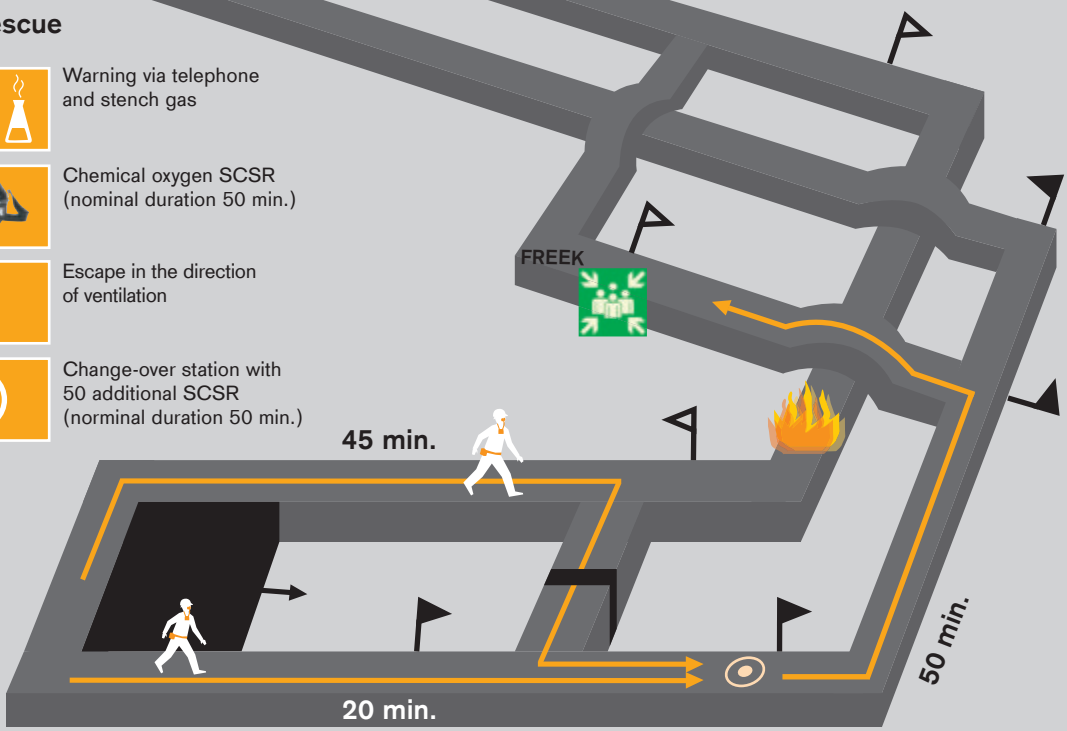
Self Rescue

Warning via telephone and stench gas

Chemical oxygen SCSR (nominal duration 50 min.)

Escape in the direction of ventilation

Change-over station with 50 additional SCSR (norminal duration 50 min.)

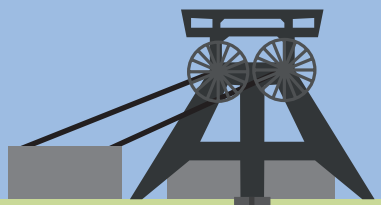


Emergency Escape Systems in Underground Mining

South Africa

Coal

Annual production output:	4.400.000 tons
Number of underground miners:	7500
Average depth:	200 m
Average travelling time to workplace:	30 min.



Mine Rescue

6 teams on site (5 each)

10 mutual aid teams

CCBA

Self Rescue

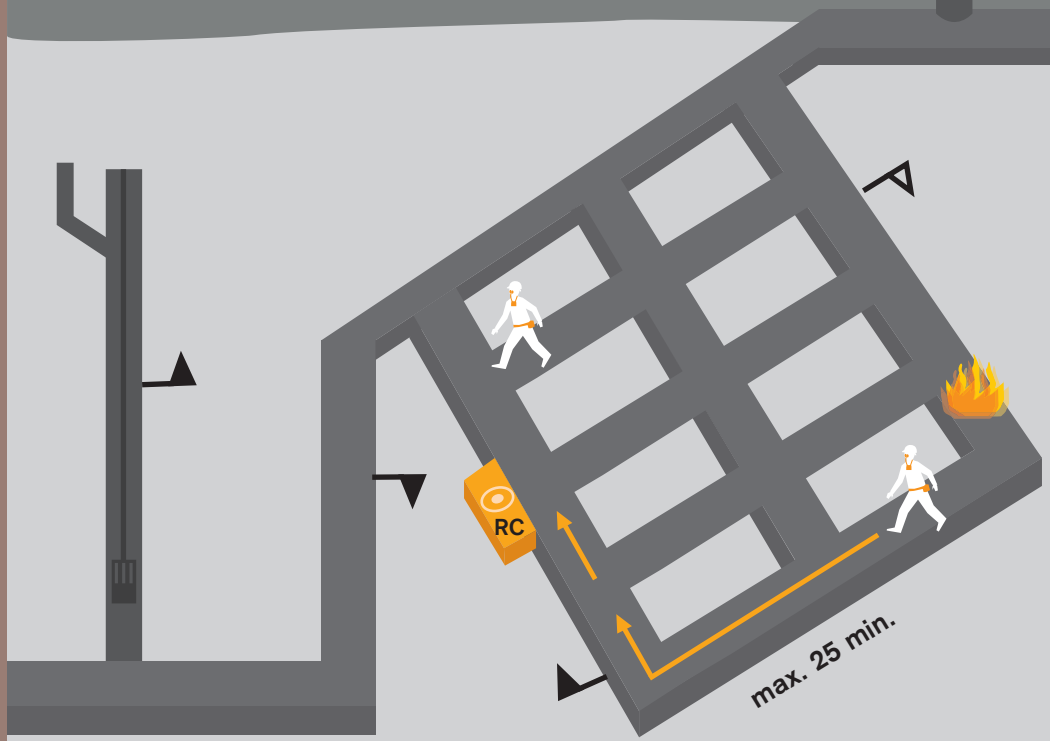
Telephone

Chemical oxygen SCSR (nominal duration 25 min. and 60 min.)

Escapeway signage

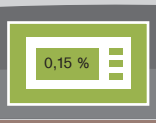
Lifeline with bobbins

Refuge chambers (500 m distance), Change-over stations with long duration set



Fire Prevention and Explosion Prevention

Smoke detector



Oxygen gas detector CH_4 monitoring, Temperature monitoring, Air velocity monitoring

Intrinsically safe electronic apparatus

Mining –

When is a mine rescue mission the only alternative?

Some extraction projects in the international mining industry extend to almost gigantic lengths and depths. Deep mining aptly describes mining at ever increasing depths – today, mining is carried out at depths that would have been unimaginable, not all that long ago. It also means that escape routes are longer and that there is no way to complete an escape entirely without any third-party assistance. Read on to find out more about escape planning, equipment and strategies for deep mines.

ESCAPE IN METAL MINES: DON'T PANIC – STAY CALM!

In ore and mineral mines, underground escape routes are often long and steep. Here, the key priority is to stay calm, find a safe refuge – for instance in a refuge chamber – and wait for rescue team organized at the surface. This is illustrated in exemplary form by escape plans for mines rescue, like those from South African gold mines.

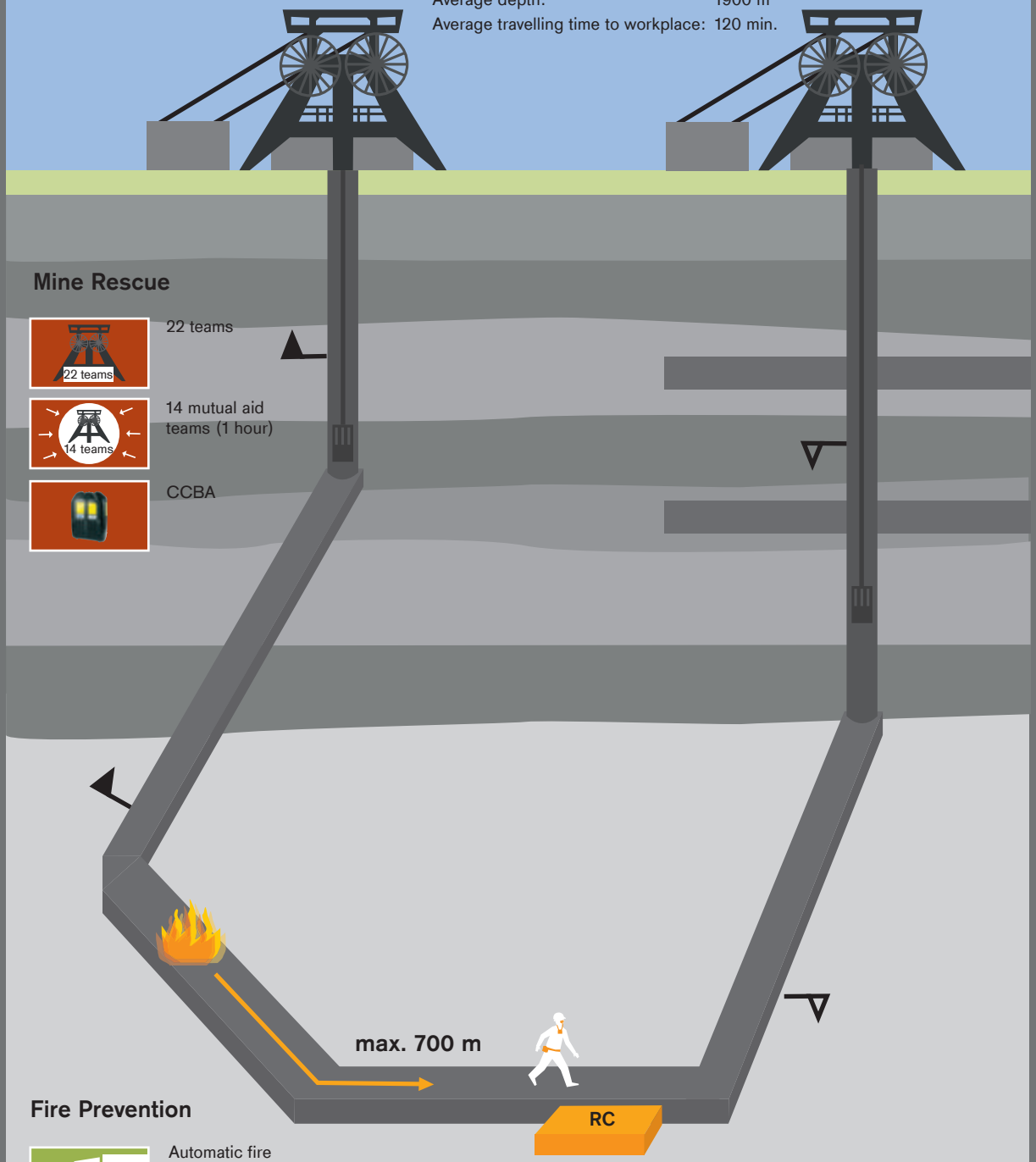
D-662-2017

Emergency Escape Systems in Underground Mining

South Africa

Gold

Annual production output:	600.000 tons
Number of underground miners:	2150
Average depth:	1900 m
Average travelling time to workplace:	120 min.



Mine Rescue

22 teams

14 mutual aid teams (1 hour)

CCBA

Fire Prevention

Automatic fire extinguishing system

Smoke detector

CO, CH_4 monitoring
Air velocity monitoring

Fire suppression system
Fire fighting equipment

Self Rescue

Telephone

Chemical oxygen SCSR (nominal duration 30 min.)

Escapeway signage
Escape route plans

39 refuge chambers (500 m distance)

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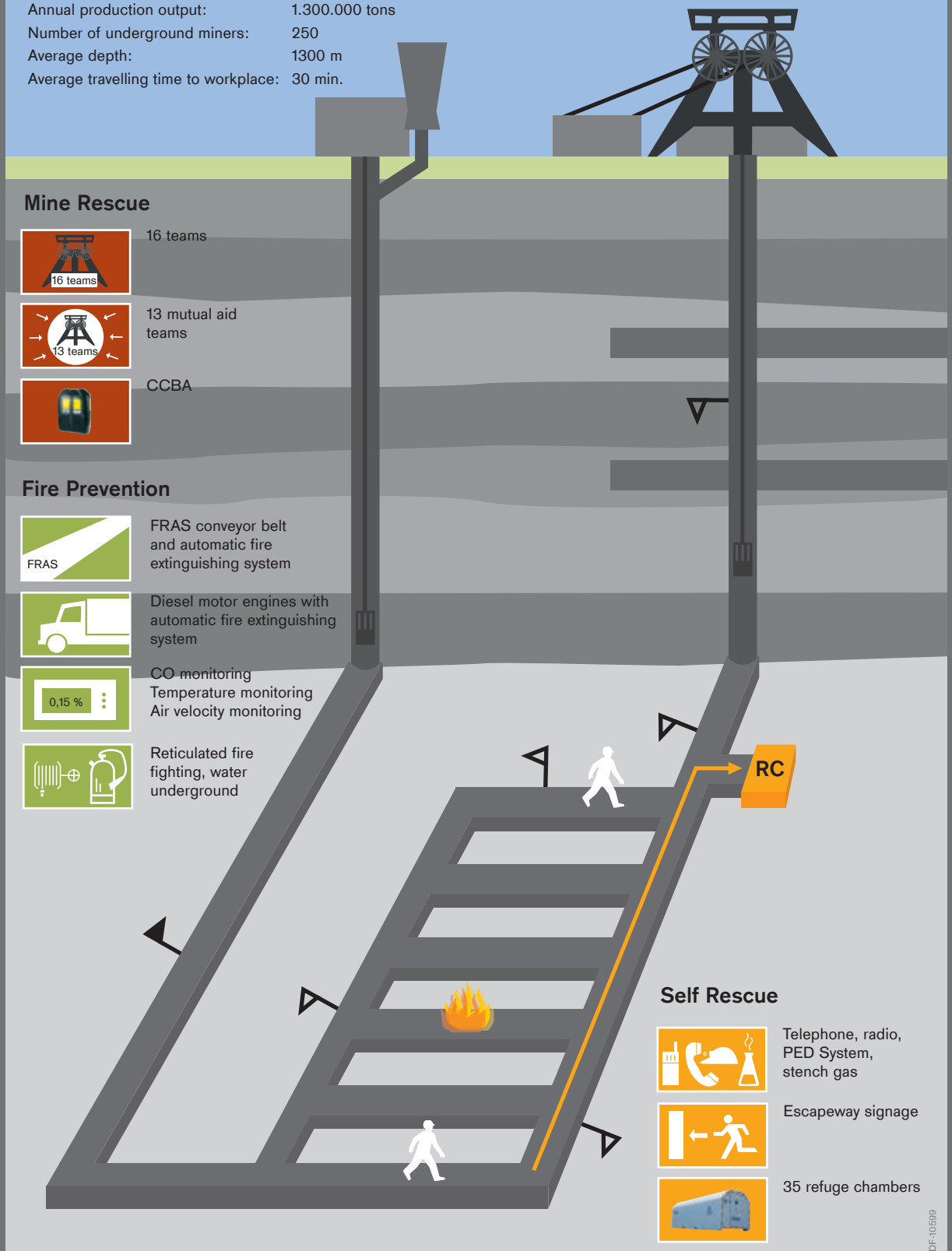
Emergency Escape Systems in Underground Mining

Canada

Nickel / Gold / Base Metal

Annual production output:	1.300.000 tons
Number of underground miners:	250
Average depth:	1300 m
Average travelling time to workplace:	30 min.



Mine Rescue

16 teams

13 mutual aid teams

CCBA

Fire Prevention

FRAS conveyor belt and automatic fire extinguishing system

Diesel motor engines with automatic fire extinguishing system

CO monitoring
Temperature monitoring
Air velocity monitoring

Reticulated fire fighting, water underground

Self Rescue

Telephone, radio, PED System, stench gas

Escapeway signage

35 refuge chambers

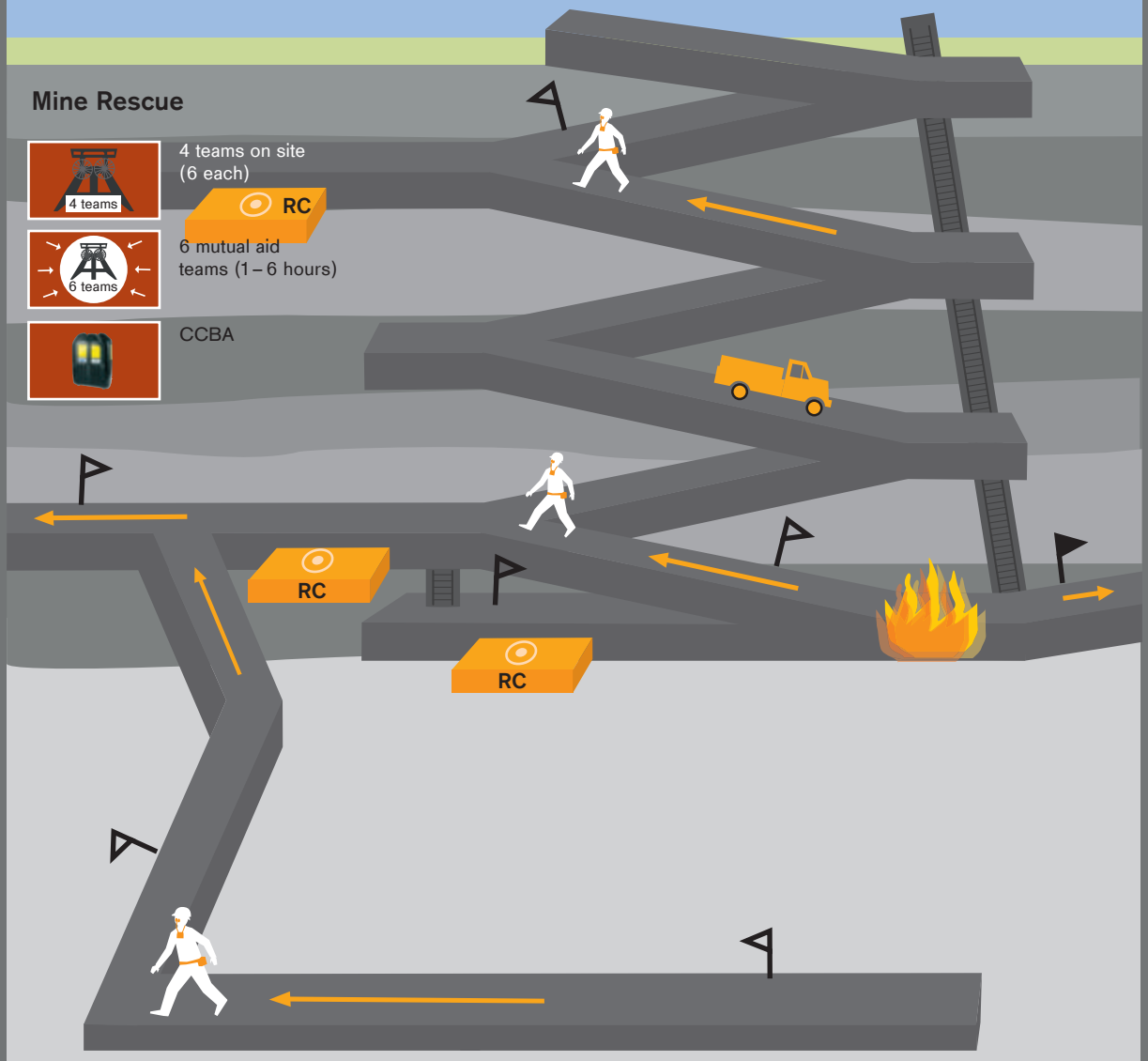
PDF-10599

Emergency Escape Systems in Underground Mining

USA

Silver / Gold

Annual production output:	125.000 ounce (gold)
Number of underground miners:	120
Average depth:	457 m
Average travelling time to workplace:	15 min. to 20 min



Fire Prevention

FRAS conveyor belt and automatic fire extinguishing system

Automatic fire extinguishing system, Fire suppression system on major equipment

CO monitoring in main ventilation areas

Fire fighting equipment, water pipes in all drifts

Self Rescue

Radio, W-LAN, stench gas

Filter self rescuer + compressed ooxygen SCSR

Escapeway signage

Primary and secondary escapeway

Change-over station

29 refuge chambers

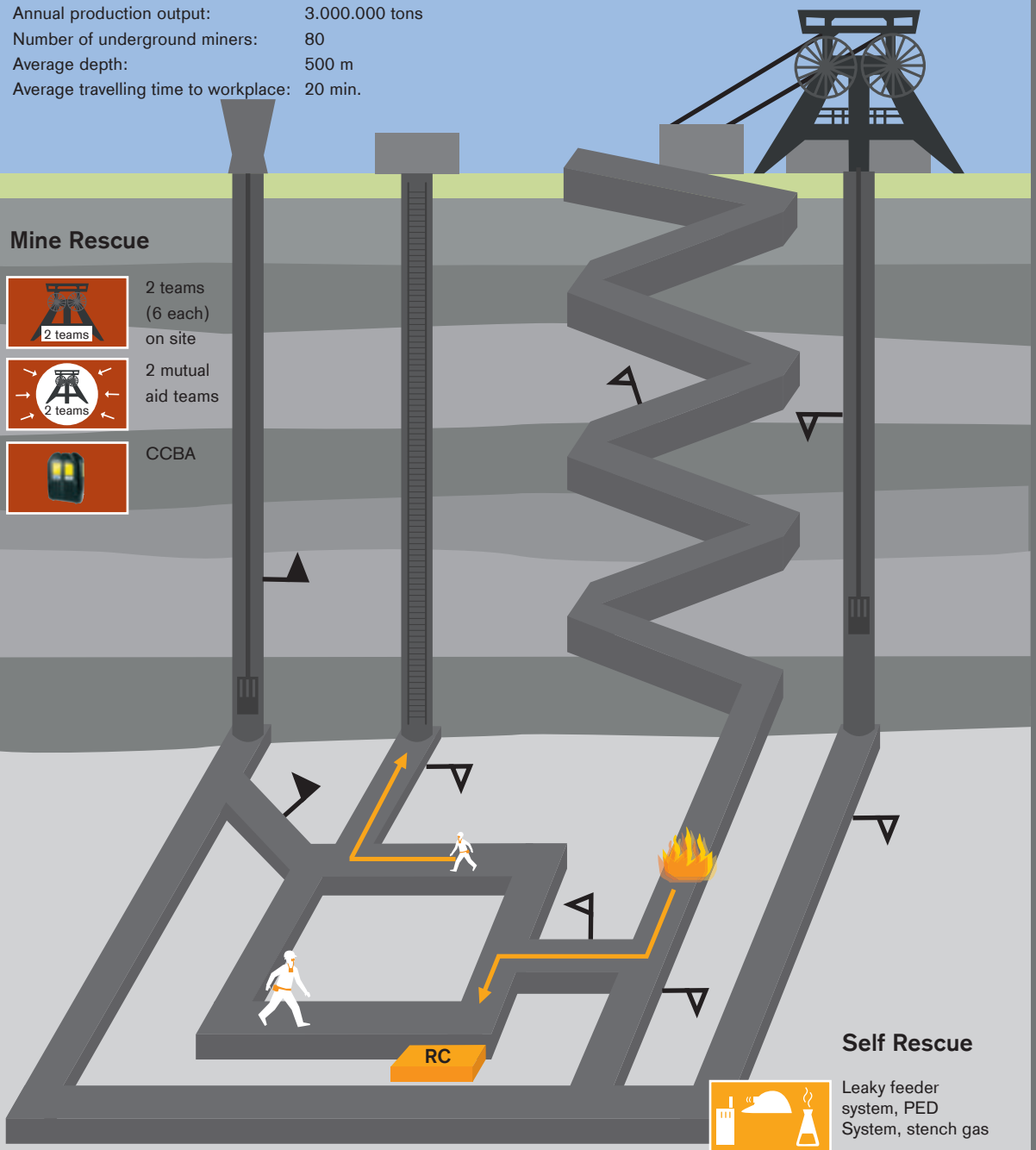
PDF-10599

Emergency Escape Systems in Underground Mining

Australia

Base Metal

Annual production output:	3.000.000 tons
Number of underground miners:	80
Average depth:	500 m
Average travelling time to workplace:	20 min.



Mine Rescue

2 teams (6 each) on site

2 mutual aid teams

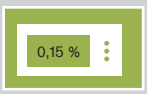
CCBA

Fire Prevention

FRAS conveyor belt and automatic fire extinguishing system

Diesel motor engines with automatic fire extinguishing system

Smoke detector



Temperature monitoring
Air velocity monitoring

Reticulated fire fighting water underground, Foam deluge system fitted to underground fuel bay

Self Rescue

Leaky feeder system, PED System, stench gas

Chemical oxygen SCSR (nominal duration 30 min.)

Underground signage
Daily information FAC (fresh air chamber)

2 ladderways in fresh air

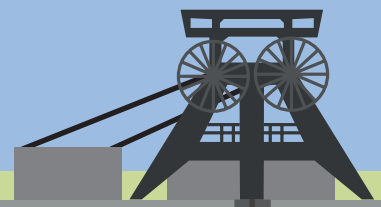
29 refuge chambers

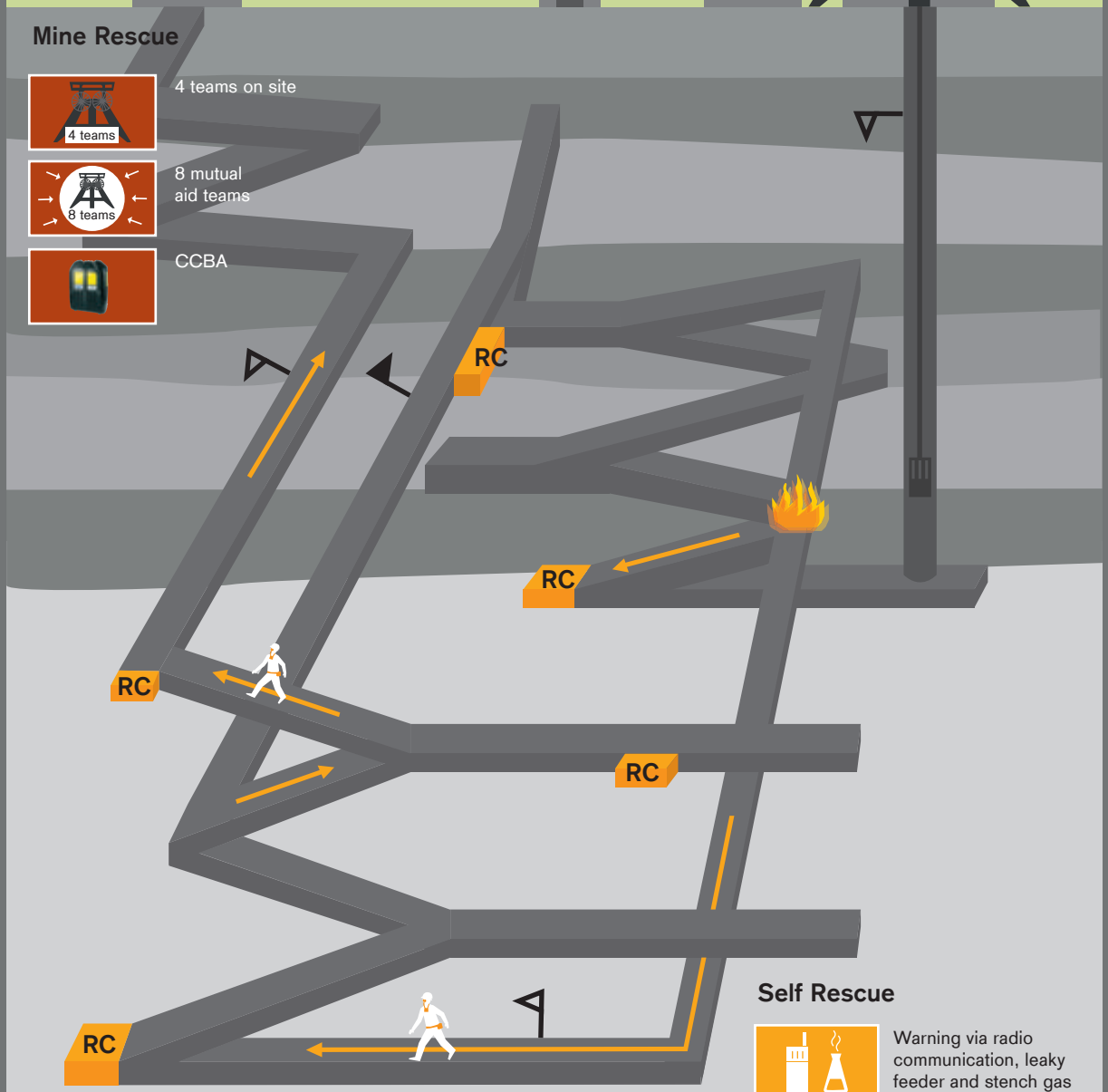
Emergency Escape Systems in Underground Mining

Canada

Zinc / Copper

Annual production output:	1.600.000 tons
Number of underground miners:	190
Average depth:	1600 m
Average travelling time to workplace:	30 – 60 min.





Mine Rescue

4 teams on site

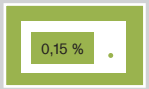
8 mutual aid teams

CCBA

Fire Prevention

FRAS conveyor belt

Diesel motor with automatic fire extinguishing systems, large mobile equipment with fire suppression systems



Gas monitoring

Foam deluge system in fuel bay

Intrinsically safe electronic apparatus

Self Rescue

Warning via radio communication, leaky feeder and stench gas

SCSR stored on vehicles (nominal duration 60 min.)

Escapeway signage by arrows

21 refuge stations (compressed air and RANA)

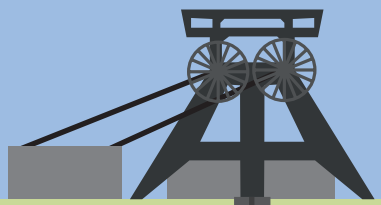
PDF-10599

Emergency Escape Systems in Underground Mining

South Africa

Diamond

Annual production output:	2.400.000 tons
Number of underground miners:	440
Average depth:	620 m
Average travelling time to workplace:	30 min.



Mine Rescue

1 team on site (4 men)

6 mutual aid teams (2,5 hour)

CCBA

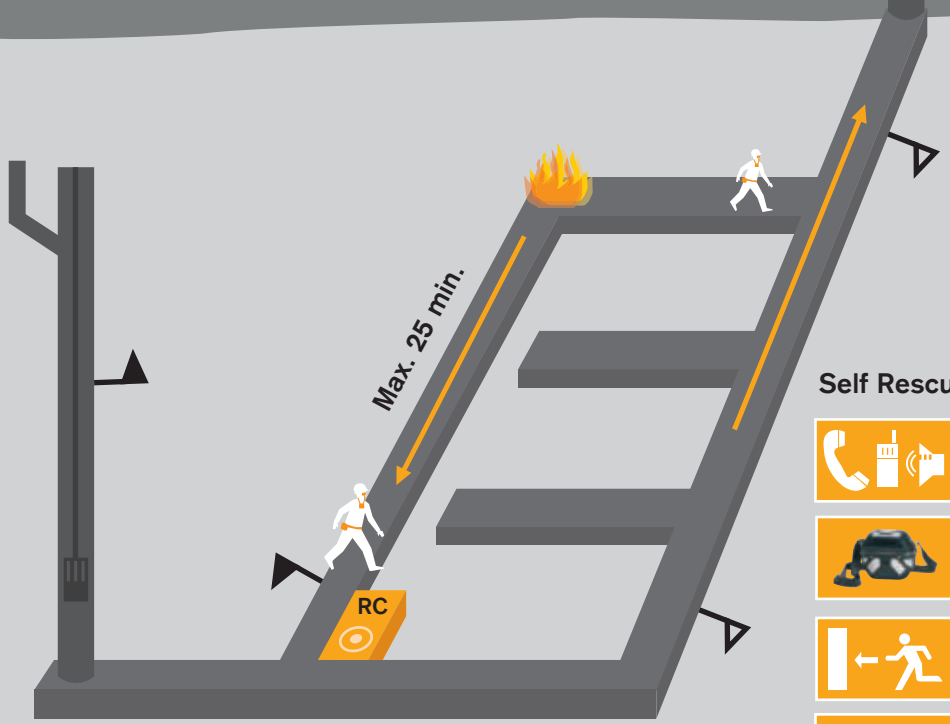
Fire Prevention

Automatic fire extinguishing system (diesel and oil tanks, tyre store)

Smoke detector

Oxygen gas detector CO, CH_4 monitoring

Fire suppression system (underground vehicles), Reciculated fire fighting water underground, Fire fighting equipment



Self Rescue

Telephone, loudspeaker, radio

Chemical oxygen SCSR (nominal duration 35 min. and 60 min.)

Escapeway signage

Change-over Station

14 refuge chambers (700 m distance)

PDF-10599

Above ground –
self-escape or rescue mission?

Above ground, emergency response plans generally anticipate self-escape and the provision of designated assembly points for mine personnel. Risk analysis provides information about any potential risks or hazards that may be involved. In downstream processing facilities, this applies particularly to toxic hazards or the risk of explosions as a result of leakage and increased concentrations of hazardous substances. Third-party rescue becomes necessary when personnel are unable to rescue themselves by escaping to a safe location. This can be the case, for example, when the atmosphere in a larger processing plant is contaminated with hazardous substances over a wide area and for a long period of time.

THE RIGHT EMERGENCY EQUIPMENT FOR INCIDENTS ABOVE GROUND

The choice of appropriate escape or rescue equipment depends on the results of risk assessment and the emergency response plan. The relevant criteria here are the degree of contamination with hazardous substances, the length of escape routes, possible oxygen deficiency, or fire.

D-8786-2009

8 points you should consider during the selection

Hazardous substances 1

Which hazardous substances (gases, vapours, particles) may be encountered? What are the threshold limit values? What maximum concentrations could be expected during an incident? Could there be a lack of oxygen?

Risk of fire and/or explosion 2

How high is the risk of a fire or explosion? Does the escape/rescue apparatus need ATEX certification? Does it have to provide protection against toxic combustion gases? Does the material have to be flameproof/fireproof?

Protection factors 3

The protection factor an escape/rescue device has to have to provide sufficient protection is derived from the determination of possible hazardous substances, the applicable threshold limit values, and the toxin concentrations in a worst case scenario.

Evacuation time 4

The emergency response plan provides the time window open for escape in certain emergency scenarios. Escape devices need to be able to provide protection for at least the duration of this time window.

Refuge areas 5

Is it possible to escape to a safe area? Is it likely that people in a safe refuge will have to wait for further evacuation measures?

Physical stresses 6

The weight and breathing resistance of respiratory protection equipment subjects the user to physical stress. This may also be accompanied by heat, extreme humidity, and poor visibility. While fulfilling safety requirements, the weight and the breathing resistance of the equipment should also be kept as low as possible.

Ease of use 7

In the case of an alarm, a fast and intuitive handling concept can provide the precious seconds that save lives. The better the handling of an escape device, the lower the risk of user errors.

Cost-effectiveness 8

Procurement costs aside, various other factors also influence the cost-effectiveness of escape devices: Service life (shelf life in storage), reusability, suitability for regular missions requiring respiratory protection, servicing requirements, and cleaning and maintenance needs.

MORE INFORMATION: WWW.DRAEGER.COM/MINING

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