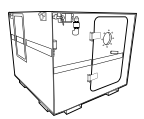
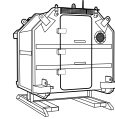
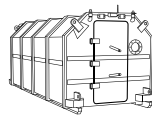


MineARC® Systems

Tunnel Refuges

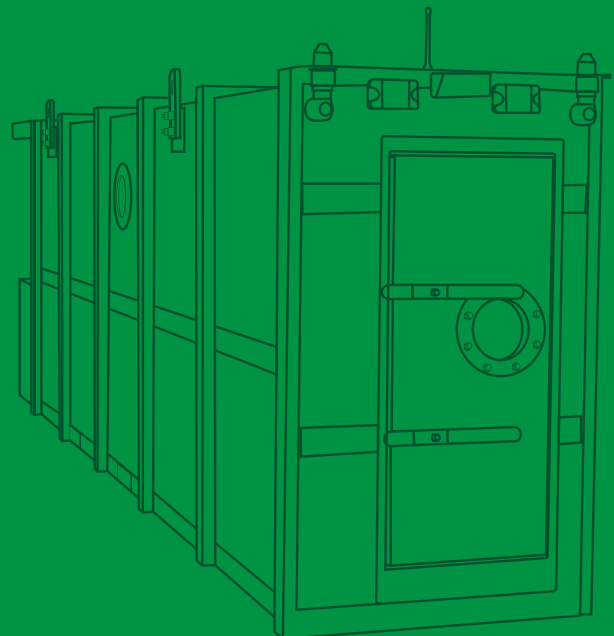
Designed to provide a refuge or 'safe-haven' for tunnel personnel trapped in a hazardous or toxic environment.



MineARC Systems - The world's leading manufacturer of emergency life-saving refuge



MineARC® Tunnel Refuge





MineARC® Systems Company Profile

MineARC Systems is a global leader in the manufacture and supply of emergency safe-refuge to the underground mining, tunnelling, and chemical processing industries.

With over 15 years of experience, our dedication to ongoing research and development has kept us at the forefront of safe refuge technology.

MineARC refuges have been successfully used around the world in multiple mine and tunnelling emergencies to save lives. MineARC has offices and manufacturing facilities in Perth, Western Australia, Pretoria in South Africa, Santiago, Chile, Fushun in China and Dallas in the United States, as well as a strong distribution network worldwide.

In total, MineARC has manufactured refuges for mining, tunneling and chemical operations in over 25 countries.

All MineARC Refuges comply with the highest international industry regulations and guidelines.

MineARC is the only refuge manufacturer in the world with an ISO: 9001 quality rating. MineARC was named winner of the 2010 West Australian Exporter of the Year Awards.

www.minearc.com



European CE Certified to Machinery Norms



Australian C-Tick Standards:
AS4100-1998, AS3570.1-18,
AS2208, AS3000, AS1716-15



United States
National Electrical Code (NEC)
2011



MineARC® HRM Refuge Live Risk Assessment Testing



Bureau Veritas ISO 9001:2008 Quality Management Systems



West Australian DMP Guidelines for Hard Rock Mines



Recent MineARC Tunneling Projects:

- Dublin Port Project, **Ireland**
- Malmo-Gothenburg Rail Project, **Sweden**
- Niagara Falls Hydro Tunnel, **USA**
- Bunol High Speed Railway, **Spain**
- Brisbane North South Bypass, **Australia**
- Castle Peak, **Hong Kong**
- West Drainage, **Hong Kong**
- Brightwater Project, **USA**
- Yucca Mountain Project, **USA**
- Express Rail Link, **Hong Kong**

Major Contractors / Manufacturers Worked With:

- Nishimatsu
- Robbins
- Herrenknecht
- Dragages
- Bilfinger Berger
- Leightons



Why The Need for Refuge?

Emergency refuge forms an integral part of a tunnelling project's wider Emergency Response Plan (ERP). Fires, fall of ground, flooding, and the release of smoke and other forms of toxic gas are the types of incidents that can occur all too frequently, despite the high levels of planning and safety precautions in place.

In these types of emergencies, where personnel become trapped without adequate ventilation and/or when evacuation is no-longer safe or practical, emergency refuge is designed to provide a safe and secure 'go-to' area for personnel to gather and await extraction.

MineARC refuges have been successfully used around the world in multiple real-life mining and tunneling emergencies to save lives.



Tunnel Industry Case Studies:

Niagara Falls, United States 2010

A compressor fire during the construction of the Niagara Falls Diversion Tunnel Project in 2010 forced 30 personnel to seek shelter inside two standard portable MineARC Tunnel Refuges for over five hours. All personnel escaped unharmed, after sheltering inside until the smoke had cleared.

Guadarrama, Spain 2003

A locomotive caught on fire during the construction of the Guadarrama Rail Tunnel, Spain in 2003 trapping 34 workers between the tunnel entrance and the TBM cutting head. Fortunately on this occasion all escaped unharmed.

Refuge Chamber Configurations

TBM Method

Systems Integration

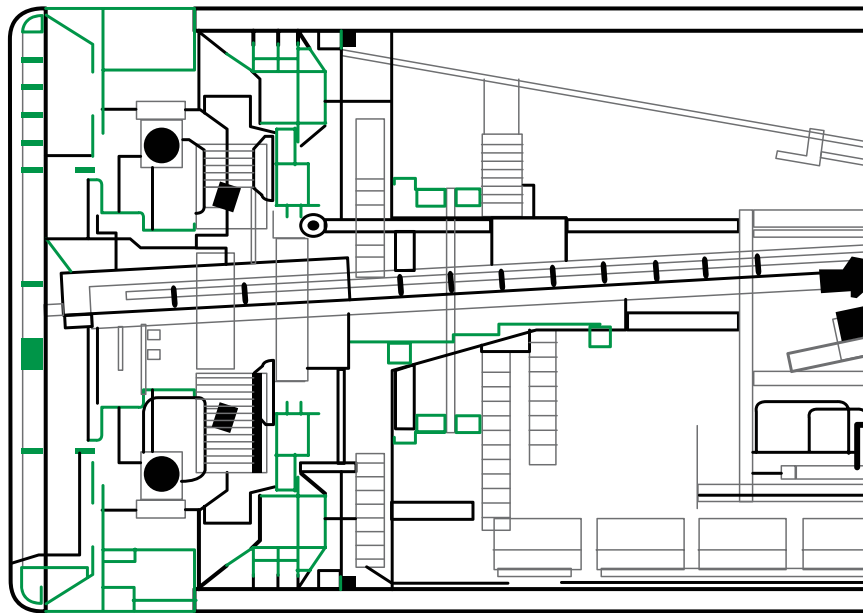
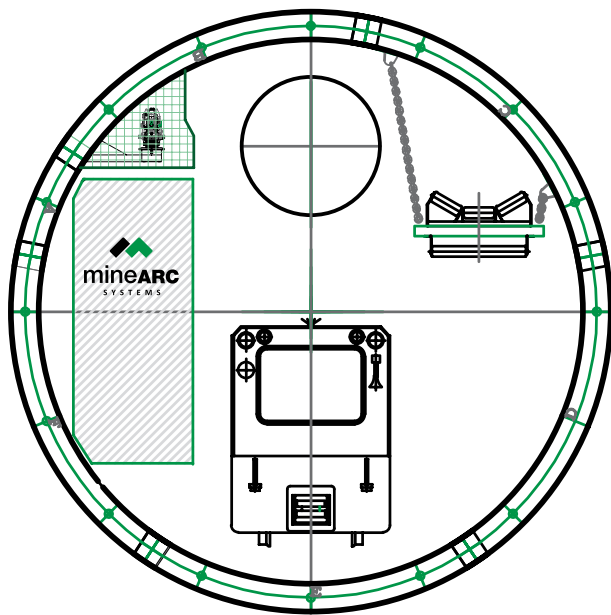
Emergency refuge should be considered within the broader context of an entire emergency response/management plan and in conjunction with a range of other important design/safety factors, including; overall tunnel design, ventilation systems, means of egress, emergency procedures and available tunnel rescue equipment.

MineARC engineers are on hand during the entire design process to ensure the best possible safety solution is delivered for each and every project.

Custom Design

Virtually all aspects of an individual tunnel refuge's design can be customized by MineARC engineers, including; standard dimensions, structural integrity, internal volume, occupancy, entry airlock/vestibule and minimum entrapment durations.

MineARC can also engineer the refuge to double as a control room, office area or rest station.



**MineARC TBM
Gantry Mounted
Refuge Chamber**



TBM Gantry Mounted Refuge

Providing safety at the rear of the cutting head infrastructure, MineARC's TBM gantry mounted refuge offers premium safety features, regardless of size constraints.

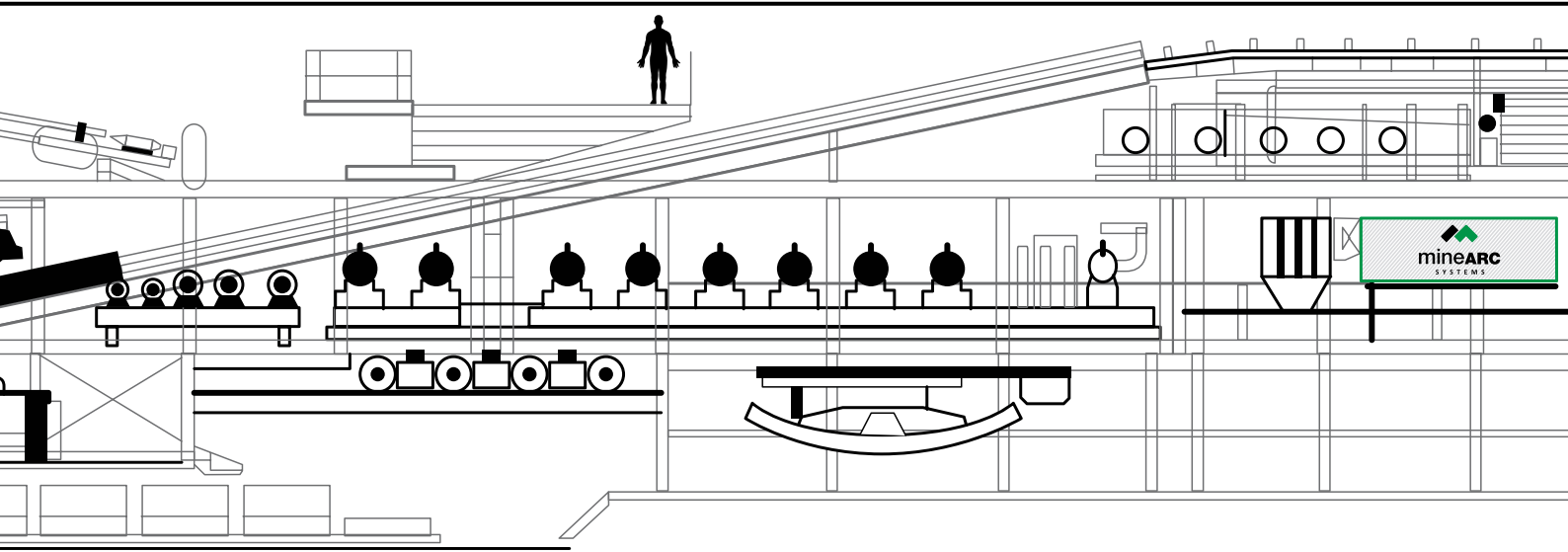
MineARC engineers can custom design and manufacture each TBM refuge to meet a project's specific needs, without compromising on occupancy potential or safety.



Rail Mounted Tunnel Refuge (Post Construction)

MineARC can custom design and manufacture various refuge models that can be rail mounted, towable or permanently located at the rear of the tunnel, serving as a safe haven for workers during routine inspections and/or maintenance works.

As a long term safety option for the life of the tunnel, the chambers are robust and fully serviceable. All refuges can be fitted with remote controls and remote monitoring systems.



Standard Portable Tunnel Refuge

MineARC's standard portable refuge models can be used in the tunneling industry where size constraints are not as restrictive. These units can accommodate up to 26 people and are ideal for tunnelling applications involving cross cuts or maintenance areas, as well as drill and blast projects.

In an emergency situation, these areas serve as an effective escape area for personnel working behind the TBM or adjacent to feeder tunnels.

MineARC Portable Refuges feature all of the same vital life support systems as TBM mounted or rail mounted refuges.





Construction

MineARC's Tunnel Refuge has been meticulously engineered to ensure ease of transport and a robust design. Constructed from 5mm (1/4") steel plate with external steel support wraps as standard, the refuge also comes equipped with lifting lugs and forklift slots to the sides.



CO/CO₂ Scrubbing with DGM

MineARC's Tunnel Refuge uses active chemicals and MineARC's patented scrubbing system to remove the buildup of harmful CO₂ (carbon dioxide) and CO (carbon monoxide) gas from inside the refuge as the occupants expire the air.

The refuge's gas monitoring systems continuously monitor and alert occupants to the internal levels of CO₂, O₂ (oxygen) and CO. Gas monitoring systems can be customised to onsite requirements.



Oxygen Supply and Air Conditioning

Every MineARC Tunnel Refuge is equipped with 3 separate sources of air supply. Under normal circumstances tunnel refuges should be connected to external (mains) air supply or ventilation (1). However, should this connection become severed or contaminated, medical grade oxygen cylinders (2) and oxygen candles (3) will continue to supply breathable air to the refuge for a minimum of 12hrs.

Air conditioning is vital to combat the potentially fatal affects of heat stress; caused by the build-up in each occupant's own metabolic activity, as well as any transient (external) heat affecting the refuge's internal temperature. All MineARC Tunnel Refuge's are therefore fitted with quality reverse cycle air conditioners.



Service and Maintenance

MineARC Refuges are easy to inspect and maintain, performing their own electrical checks whilst requiring minimal general preventative maintenance. The refuge also has a low ongoing cost of ownership, with consumables (such as the active chemicals used in the scrubbing system) having extended shelf lives.

Battery Back-Up (UPS)

MineARC Tunnel Refuges are designed to run off a project's 'mains' electrical power supply, operating indefinitely once connected. However, in the event that mains power is lost, the refuge is equipped with its own battery UPS (Uninterruptable Power Supply), capable of powering all internal life support systems for a minimum of 12hrs, stand-alone.



Features Summary

MineARC® Tunnel Refuge



- ▶ **5mm (1/4")** Steel Plate Construction
- ▶ **3 Sources** of Air Supply
- ▶ **CO & CO₂ Scrubbing**
- ▶ **Digital Gas Monitoring**
- ▶ **Air-Conditioning**
- ▶ **12hrs** Minimum Stand-Alone Duration
- ▶ **Optional 15PSI** Blast Resistance



STANDARD FEATURES

- ✓ 5mm (1/4") Steel Plate Construction
- ✓ 3 Sources of Air (Oxygen) Supply
- ✓ Carbon Dioxide (CO₂) and Carbon Monoxide (CO) Scrubbing with Digital Control System
- ✓ Air Conditioning and Dehumidifying
- ✓ Fire Resistance
- ✓ Battery Back-UPS 12hrs Minimum Life Support
- ✓ Digital Gas Monitoring (DGM)
- ✓ Viewing Portal
- ✓ Rear Escape Hatch
- ✓ Ergonomically Designed Seating
- ✓ Lifting and Towing Lugs
- ✓ Forklift Slots
- ✓ Non-Slip Flooring
- ✓ Chemical Toilet
- ✓ Internal and External Fire Extinguishers

OPTIONAL FEATURES

- ✓ Special Transport Configurations (Rail Mounted, Remote Control Operation, Raised Skid Base)
- ✓ Internal Office Space / Rest Area Configuration
- ✓ Separate Air Lock / Vestibule Entry Compartment
- ✓ 15 PSI Explosion Proof Construction
- ✓ Battery Back-UPS Upgrade to 24hrs
- ✓ Remote Internal Video Monitoring
- ✓ First Aid Kit (Standard on US Models)
- ✓ Step-Down Transformer



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