Tunnelling Refuge Chambers

TunnelSAFE Nordic Design

Designed to provide a refuge or safe haven for tunnel personnel, meeting specifications outlined in Norway's Tunnelling Handbook.

mineARC SYSTEMS | tunnelSAFE NORDIC DESIGN

ITA INTERNATIONAL TUNNELLING AND UNDERGROUND SPACE ASSOCIATION

NORWEGIAN TUNNELLING SOCIETY

TunnelSAFE
Nordic Design

MineARC Systems - Built for Safety. **www.minearc.com**

mineARC SYSTEMS

Company Profile

MineARC Systems is the global leader in the manufacture and supply of emergency safe refuge solutions for the mining, tunnelling, chemical processing and disaster relief industries.

With over 20 years' experience, our dedication to ongoing research and development is driven by our key focus to continually offer the best and most advanced safety solutions on the market.

Our team of qualified engineers, electrical designers and technical experts form a global network across several international locations including;

- Perth, Western Australia
- Johannesburg, South Africa
- Dallas, Texas
- Santiago, Chile
- León, Mexico
- Beijing, China
- Reading, UK

This allows MineARC to provide 24 hour service and engineering support to our expanding list of clients in over 65 countries across the globe.

All MineARC Refuge Chambers and Safe Havens comply with the highest international regulations and recognised 'world's best practice' industry guidelines. Our key focus on quality control and product advancement has meant that MineARC Refuge Chambers have successfully saved lives in multiple real life industrial emergencies around the globe.

www.minearc.com

mineARC SYSTEMS | tunnelSAFE

Bureau Veritas ISO 9001:2008 Quality Management Systems

BSI (British Standard) BS 6164:2011 Health and Safety in Tunnelling

ITA INTERNATIONAL TUNNELLING AND UNDERGROUND SPACE ASSOCIATION

INTERNATIONAL TUNNELLING AWARDS 2018 WINNER

Member of the ITA (International Tunnelling Association)

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

Canadian Standards Association (CSA)

nec®

United States National Electrical Code (NEC) 2013/14

CE

European CE Certified to Machinery Norms

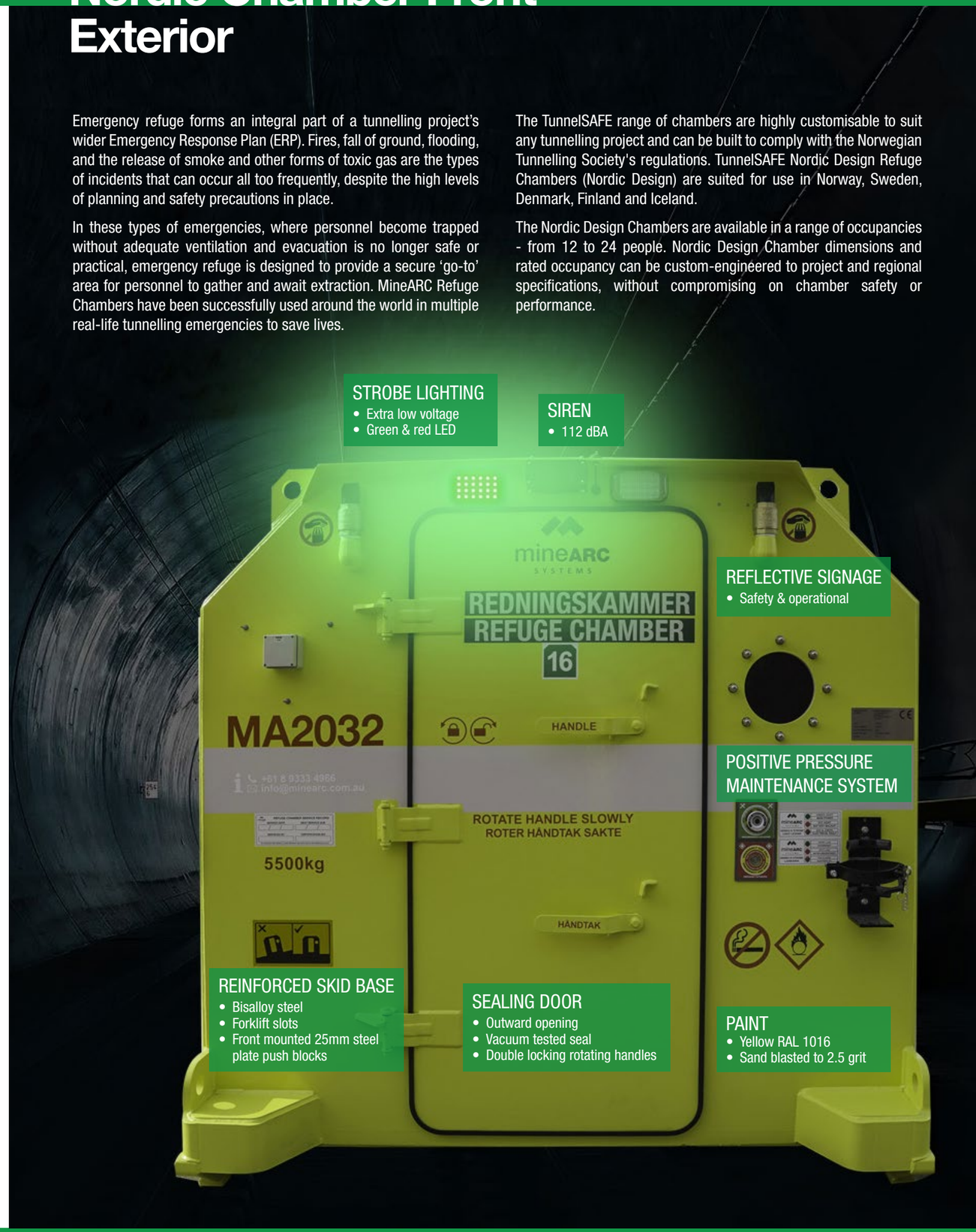
Nordic Chamber Front Exterior

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 evacuation is no longer safe or practical, emergency refuge is designed to provide a secure 'go-to' area for personnel to gather and await extraction. MineARC Refuge Chambers have been successfully used around the world in multiple real-life tunnelling emergencies to save lives.

The TunnelSAFE range of chambers are highly customisable to suit any tunnelling project and can be built to comply with the Norwegian Tunnelling Society's regulations. TunnelSAFE Nordic Design Refuge Chambers (Nordic Design) are suited for use in Norway, Sweden, Denmark, Finland and Iceland.

The Nordic Design Chambers are available in a range of occupancies - from 12 to 24 people. Nordic Design Chamber dimensions and rated occupancy can be custom-engineered to project and regional specifications, without compromising on chamber safety or performance.



Nordic Chamber Interior

Nordic Chamber Interior

Inside a MineARC TunnelSAFE Refuge Chamber, a number of vital life support systems combine to create a safe, ongoing environment for occupants.

Systems include primary and secondary oxygen supplies, air conditioning and dehumidifying, positive pressure maintenance, electrical and communications, gas detection and CO/CO_2 absorption (referred to as 'scrubbing' systems).

MineARC TunnelSAFE Chambers use active chemicals and MineARC's Extra-Low-Voltage (ELV) Scrubbing System to 'scrub' the build-up of harmful CO_2 and CO from the air inside the refuge chamber.

In high enough concentrations, both CO_2 and CO can cause serious injury leading to a loss of consciousness and eventually, death. CO_2 and CO are expired by occupants as part of their normal breathing activity. Carbon Monoxide can also enter the main chamber via the compressed air intake (if it becomes compromised), and as occupants enter and/or exit the main

Air Conditioning

Air conditioning is vital to combat the potentially fatal effects of heat stress. A continuous build up in heat is caused by the occupant's metabolic activity, as well as any ambient (external) heat affecting the refuge chamber internal temperature.

Optional: Automated Oxygen Delivery System

The MineARC Automated Oxygen Delivery System (AODS) is designed to maintain a safe, breathable atmosphere within the refuge chamber.

Once the system is activated, the AODS disperses metered amounts of oxygen supplied by a compressed oxygen cylinder, based on Aura-FX gas readings. The AODS maintains oxygen levels between 18.5% and 23% inside the refuge chamber when the external fresh air supply has been compromised or is unavailable.

Nordic Chamber Exterior Sides & Rear

A blast resistant cabinet at the rear of the TunnelSAFE Nordic Chamber houses the refuge chamber's UPS battery back up (Uninterruptible Power Supply). The UPS is a fail-safe system that can power the refuge chamber's internal life support systems for a minimum of 24hrs, should underground power become cut-off.

Eye-catching bright yellow paint (RAL 1016) plus a wide-band 100mm silver reflective strip will aid underground personnel to locate the Nordic Chamber in an emergency.

The reinforced skid base of bisalloy steel, plus forklift slots and 25mm steel plate push blocks allow easier chamber positioning.

Optional: Satellite UPS System

MineARC's Satellite Uninterruptible Power System (SUPS) has been engineered specifically for use in conjunction with refuge chambers; designed to ensure batteries perform at full capacity for their expected life span.

By ensuring atmospheric conditions are optimal, monitoring battery activity and adding electronics to the charging system, the Satellite UPS System limits all primary aspects of battery degradation and allows MineARC's high quality batteries to operate as intended.

For more information, please visit **www.minearc.com**

Pressure Systems

MineARC pressure systems are designed to help maintain a safe, breathable atmosphere within the refuge chamber. Systems include the Pressurised Access Safety System (PASS) to ensure safe entry into the refuge chamber, and the Positive Pressure Maintenance System (PPMS) to maintain positive internal pressure within the chamber.

Pressurised Access Safety System

The Pressurised Access Safety System (PASS) remote activation unit is located next to the door on the front exterior of the refuge, allowing personnel to pre-prepare the chamber for safe entry.

Should the chamber's fresh compressed air supply be disconnected or compromised, the system's external LED light will display red, indicating that the chamber is not positively pressurised and therefore unsafe for entry.

Once activated, the PASS will disperse controlled quantities of compressed air into the chamber until the internal pressure reaches 200 Pa. By ensuring that the pressure inside the refuge is slightly greater than outside, toxic contaminants are prevented from infiltrating the chamber during entry of personnel.

Positive Pressure Maintenance System

The Positive Pressure Maintenance System (PPMS) enclosure is securely mounted to the interior wall of the refuge chamber. Powered by a 24VDC power supply, the electric solenoid valve opens and closes to release measured amounts of breathable air from compressed air cylinders in order to maintain a positive internal pressure.

The quantity of compressed breathable air cylinders is configurable to suit various internal volumes and durations of operation.

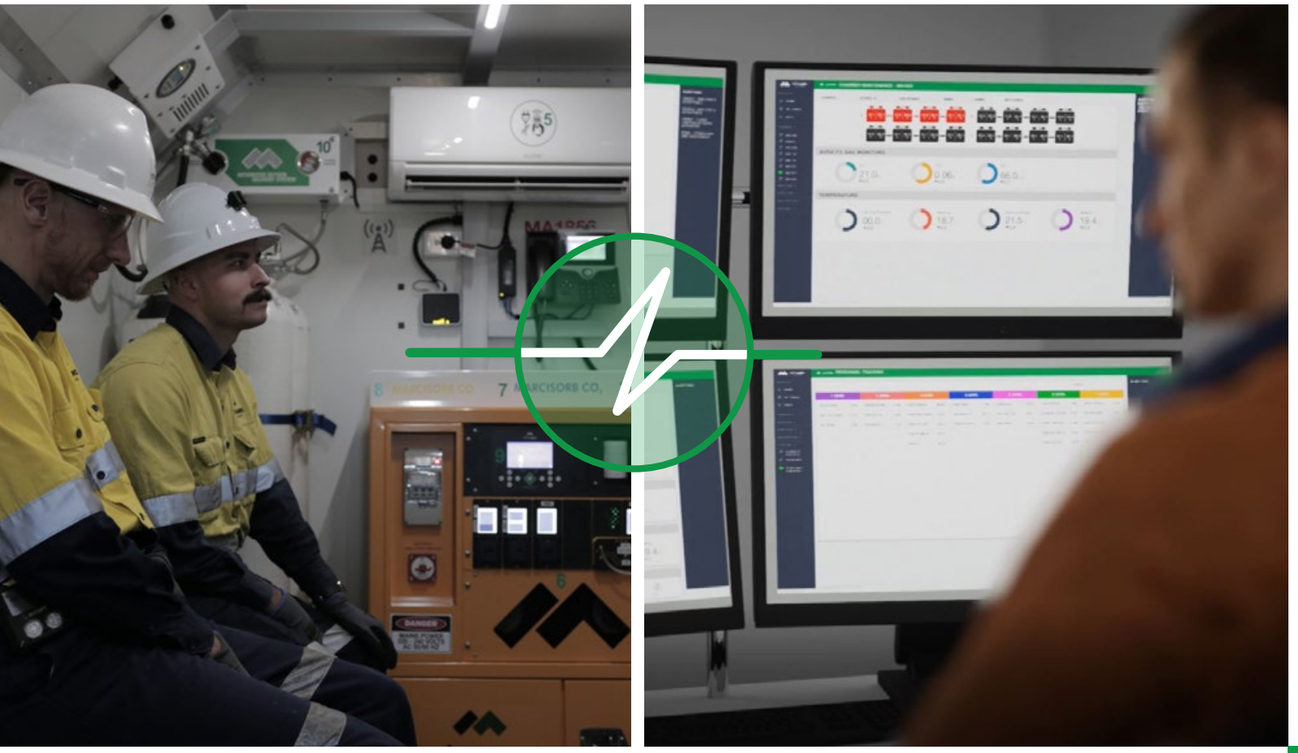
GuardIAN
Chamber Monitoring

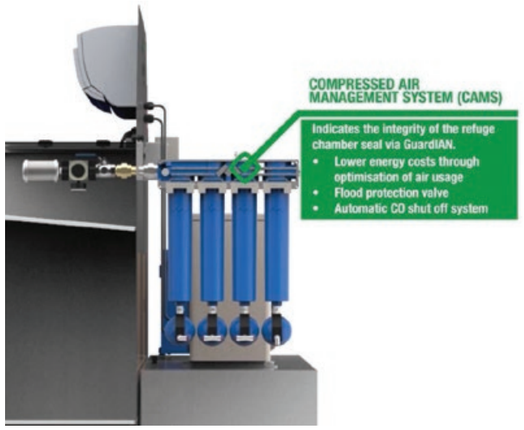
MineARC's **GuardIAN Refuge Chamber Monitoring System** is an exciting development in refuge chamber technology. GuardIAN enables real-time monitoring; providing confidence that an operation's fleet of refuge chambers are emergency ready at all times.

GuardIAN Refuge Chamber Monitoring is an on-board system that continuously monitors all vital refuge operating systems. During standby mode GuardIAN checks for component faults and monitors refuge chamber usage or entry to the chamber.

The GuardIAN Chamber Monitoring system is hosted on an internal server within the refuge chamber so that no client software installation is required. The responsive webpage is easily accessible from any computer, tablet or smartphone and features a summary of your entire refuge chamber fleet and overall operational status, with the ability to drill down to a detailed report of each chamber.

GuardIAN Chamber Monitoring provides the added advantage of remote troubleshooting assistance by MineARC Engineers, who can login to view the chamber diagnostics dashboard with sites' permission.





Chamber Integrity Monitoring

available for chambers equipped with CAMS

The Compressed Air Management System (CAMS) communicates vital information relating to the integrity of the internal refuge chamber via the GuardIAN Network.

An increase in CAMS activity would indicate a breach of the refuge chamber seal, thus sending an alert to designated personnel that the chamber is compromised.

GuardIAN
Chamber Monitoring

Event Logging & Fault Diagnostics

MineARC's Digital Controller links directly to GuardIAN, streaming realtime system data to a surface control room(s). Data includes automated system checks, battery fault logging, system diagnostics, internal and external temperature measurements, and system actions such as scrubber activation.

System faults, events and scheduled service notifications can be sent to designated personnel as email alerts; notifying them of upcoming service requirements, potential emergencies or mal-use as they occur.

Live Video Monitoring & VOIP Video Phone

Internal video monitoring is provided by a remote controlled, motion activated GuardIAN IP camera. When activated, the camera will send out a live, recorded stream of the interior of the refuge chamber to the GuardIAN Network.

To assist occupants during an emergency or safety drill, chambers are also equipped with a VOIP video phone, facilitating face-to-face communication between the refuge chamber and the surface.

UPS Battery Management

When used in conjunction with GuardIAN, the MineARC Satellite UPS System allows for real-time, remote monitoring of each individual battery. Battery faults can be identified immediately via the GuardIAN Dashboard and Alert Feed, with auto-generated event notifications sent directly to any personal device. Voltage and temperature diagnostics for each individual battery within a string can also be viewed via a graph, highlighting any fluctuations over the past 24 hours.

Complete your network with GuardIAN Connect

GuardIAN Connect, powered by RFI Technology Solutions is a high speed, fit for purpose, linear access layer network, allowing the connection of the GuardIAN Nodes, Smart Lighting and Refuge Chamber to the GuardIAN Intelligence Network.

Designed specifically for an underground and industrial environments, GuardIAN Connect uses a single coaxial cable to carry both power and data.

Custom Design & Chamber Options

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

Virtually all aspects of a MineARC TunnelSAFE chamber design can be customised by MineARC Engineers, including; shape, standard dimensions, blast resistance, internal features, occupancy, entry airlock/vestibule and minimum entrapment durations. MineARC can also engineer the refuge chamber to double as a control room, office area, rest station or blast room (used in drill and blast operations).

Custom TunnelSAFE Refuge Chamber

Permanent Shelter, as opposed to a Portable Refuge Chamber, can prove to be a more efficient and cost effective solution for underground working locations.

A permanent shelter (or crib room) can work well as an emergency refuge facility for tunnelling sites that have a large number of personnel underground at any one time. Permanent refuge chambers are capable of sheltering a larger workforce in an underground emergency, and can also double as break, rest and lunch area during normal operation.

Permanent Refuge Solutions

45° Angle Front Entry

Auto-Retracting Seating

Feature Summary

- **Regulation Compliance** Norwegian Tunnelling
- **Paint** Yellow RAL 1016
- **Reflective Strip & Signage**
- **Reinforced Skid Base** Bisalloy steel
- **Rear Blast Shield** Battery protection
- **Breathable Air Supply**
- **CO & CO_2 Scrubbing**
- **Aura-FX Digital Gas Monitoring**
- **Air-Conditioning**
- **24hr Battery Backup**
- **PPMS & PASS**

Optional Features

- Custom dimensions and transport configurations
- Compressed Air Management System (CAMS)
- Fully flushing, pressurised airlock
- Misting system for external temperature control
- Battery backup UPS upgrade or satellite system
- First aid kit
- Internal LCD monitor screen
- Step-down transformer
- Carbon Monoxide Safety-Off-System (COSOS)
- Automated Oxygen Delivery System (AODS)
- GuardIAN Intelligence Network

Optional Add-Ons: Emergency Response Products

MineARC's **ZOLL AED Range** provides the best support to help save a life. Users are provided with real-time feedback for quality, depth and rate of chest compressions; providing confidence and clarity throughout the defibrillation process.

The **Rugged Oxygen Generator (ROG)** is a portable, lightweight oxygen generator that delivers 90 litres of breathable oxygen for 15 minutes. Easy-to-use and small enough to carry in a backpack, the ROG gives immediate access to a potentially life saving oxygen supply.

MineARC Systems - Built for Safety. www.minearc.com

mineARC
SYSTEMS