Hard Rock Mine Refuge Chambers

MineARC's MineSAFE Essential Design Range

Offering the essential features required to sustain life during an emergency whilst maintaining the superior quality of a MineARC-engineered refuge chamber.

mineARC SYSTEMS | mineSAFE ESSENTIAL DESIGN

MS-ED2-12-ELV-36

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

mineARC SYSTEMS

MA-416

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 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
- Beijing, China
- Barcelona, Spain
- Guanajuato, Mexico

This allows MineARC to provide 24 hour service and engineering support to our expanding list of clients in over 60 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.

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Bureau Veritas ISO 9001:2008 Quality Management Systems

MineARC® HRM Refuge Live Risk Assessment Testing

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

Canadian Standards Association (CSA)

United States National Electrical Code (NEC) 2013/14

European CE Certified to Machinery Norms

Helping safeguard miners in over 40 countries, across six continents, the MineARC MineSAFE Series is the world's most trusted refuge chamber in metal (hard rock) and non-metal mines.

Emergency refuge forms an integral part of an underground mine's wider Emergency Response Plan (ERP). Fires, explosions, rock-falls, flooding, and the release of smoke and other forms of toxic gas are the types of incidents that occur all too frequently, despite the high levels of planning and the safety precautions in place.

In these types of emergencies, 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 mine and tunnelling emergencies to save lives.

Refuge chambers should be deployed throughout the mine to create a refuge 'network' accessible to all underground personnel whilst on foot. Depending on the country/region, regulations usually state acceptable 'safe distances' between refuge chambers.

MS-ED1-08-ELV-36

Standard Configurations

In consultation with the world's leading mining companies and regional mining authorities, the MineSAFE Range has been continuously re-engineered and refined to create a safe-refuge alternative that is fully integrated with today's modern underground mining environment.

The MineSAFE Essential Design (ED) provides the most cost effective alternative to MineARC's flagship Standard Design refuge chamber. The ED chamber offers all of the critical features required to sustain life during an emergency whilst maintaining the quality of a MineARC-engineered refuge chamber.

MS-ED2-12-ELV-36
12 Person

The Essential Design is designed specifically to accommodate tight mining confines such as shaft mines, while still providing ample internal space for a range of occupancies - from 8 to 30 people. The chamber's narrow design makes it easy to manoeuvre and position around site.

Ultimately a refuge chamber's dimensions and rated occupancy can be custom-engineered to suit site specifications, without compromising on safety or performance.

MS-ED1-08-ELV-36 (8 Person)

MS-ED2-12-ELV-36 (12 Person)

MS-ED3-16-ELV-36 (16 Person)

MS-ED4-20-ELV-36 (20 Person)

MS-ED5-26-ELV-36 (26 Person)

MS-ED6-30-ELV-36 (30 Person)

Standard Dimensions

Model	Occupancy (persons)	Height (m/inch)	Width (m/inch)	Length (m/inch)	Weight (kg)
MS-ED1-08-ELV-36	8	2.10 / 82	1.90 / 74	4.20 / 165	3,710
MS-ED2-12-ELV-36	12	2.10 / 82	1.90 / 74	4.80 / 188	3,937
MS-ED3-16-ELV-36	16	2.10 / 82	1.90 / 74	6.02 / 237	4,844
MS-ED4-20-ELV-36	20	2.10 / 82	1.90 / 74	7.24 / 285	5,978
MS-ED5-26-ELV-36	26	2.10 / 82	1.90 / 74	8.44 / 332	6,658
MS-ED6-30-ELV-36	30	2.10 / 82	1.90 / 74	9.75 / 384	7,350

Custom dimensions and occupancies available. Refuge dimensions are ultimately designed to client specifications.
Weights provided are Australian standard 36hr models.
Indicative weights only. Custom variations will impact final refuge chamber weight.

Chamber Exterior Front

MS-ED2-12-ELV-36

The exterior front represents the 'face' of the refuge chamber - designed primarily for easy identification, and quick, easy access during an emergency.

The emergency lighting systems, warning siren and reflective signage alert passers-by to the chamber's location, whilst the rotating door handles provide simple, straight forward access to the safety of the interior.

Also Available: EnviroLAV Toilet System

The EnviroLAV is the latest innovation in self-contained, portable toilet systems – ideal for the use in underground mining.

Designed to be simple to operate and maintain, the EnviroLAV is a semi-permanent structure that can be used both above and below ground wherever there is access to compressed air or electricity. The EnviroLAV requires emptying just once every 12 months, based on standard usage in optimal conditions.

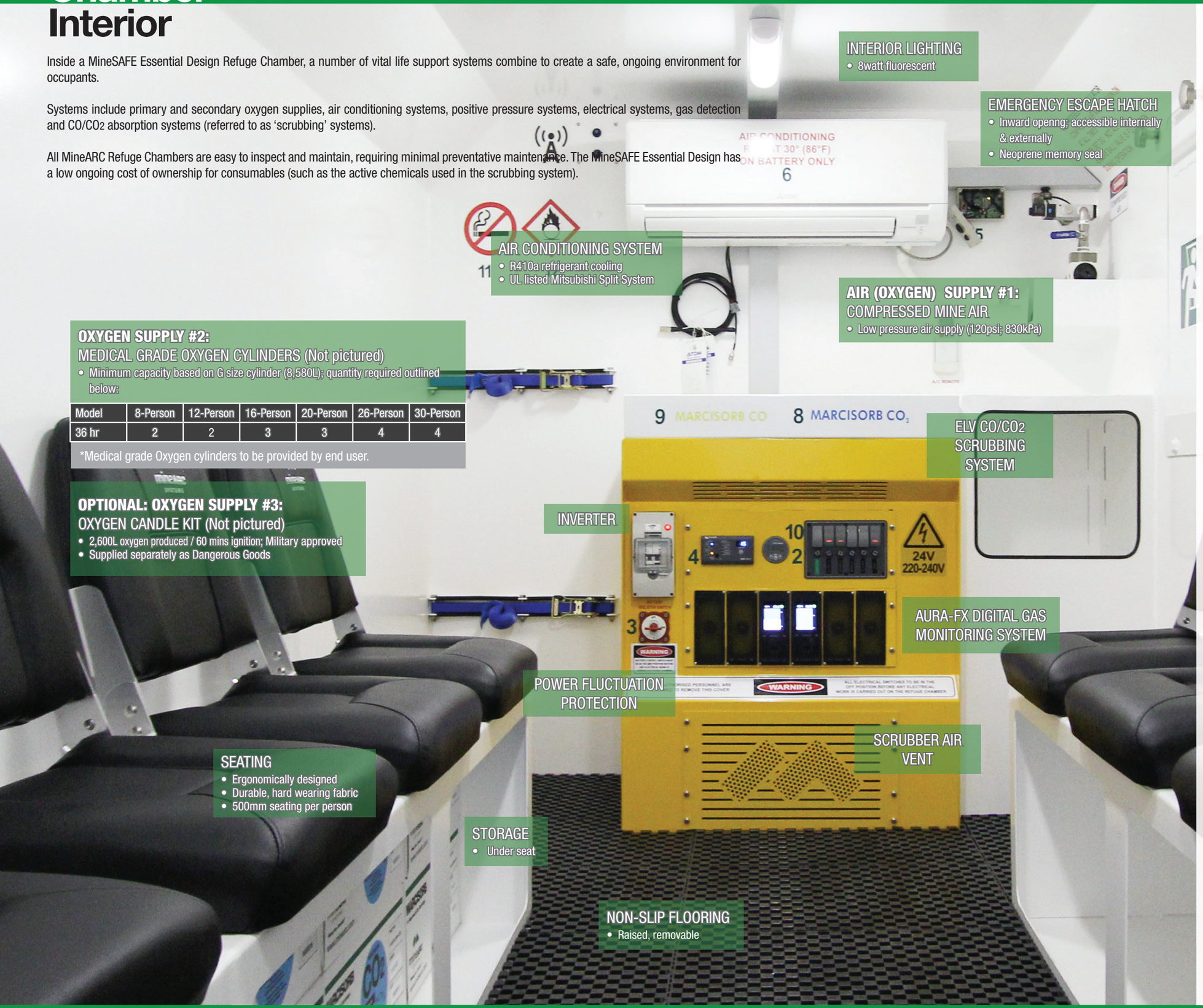
For more information please visit **www.minearc.com**

Chamber Interior

Inside a MineSAFE Essential Design 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 systems, positive pressure systems, electrical systems, gas detection and CO/CO_2 absorption systems (referred to as 'scrubbing' systems).

All MineARC Refuge Chambers are easy to inspect and maintain, requiring minimal preventative maintenance. The MineSAFE Essential Design has a low ongoing cost of ownership for consumables (such as the active chemicals used in the scrubbing system).



Control System

The controller interface is the operational hub of the refuge chamber. From here all power, lighting and scrubbing systems can be managed with the flick of a switch.

Standard: ELV System

MineARC's ELV (extra-low-voltage) System comes as standard with the MineSAFE Essential Design.

The ELV Control System is installed in conjunction with a UPS battery backup that can power the system for a minium of 36hrs, should mine power be cut off.

Optional Upgrade: Series IV System

The Series IV Electrical Scrubbing System is considered to be the most advanced safe refuge technology in the world.

Exclusive to the Series IV Control System is i.V.A.N (Intelligent Voice Audio Navigation); an on-board navigation assistant that guides occupants through operational procedures. Additional benefits of the Series IV System include superior digital control, intuitive operation and motion sensor logging.

The Series IV Control System is installed in conjunction with a UPS battery backup that can power the system for a minimum of 36hrs, should mine power be cut off.

MARCISORB Chemical Cartridges

MineARC's Scrubbing Systems use pre-packaged MARCISORB chemical absorber cartridges to 'scrub' the build up of harmful CO_2 (carbon dioxide) and CO (carbon monoxide) 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 the 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 entrance, making CO/CO_2 scrubbing a vital necessity.

MineARC's MARCISORB CO and MARCISORB CO_2 cartridges provide superior scrubbing capacity, are easy to load, safe to handle, and can store for long periods.

Air Conditioning

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

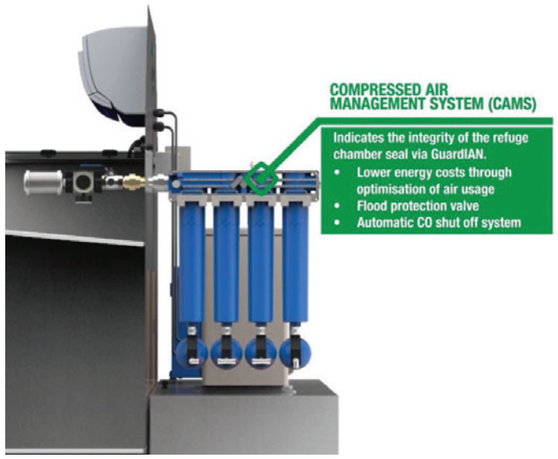
GuardIAN
Chamber Monitoring

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.

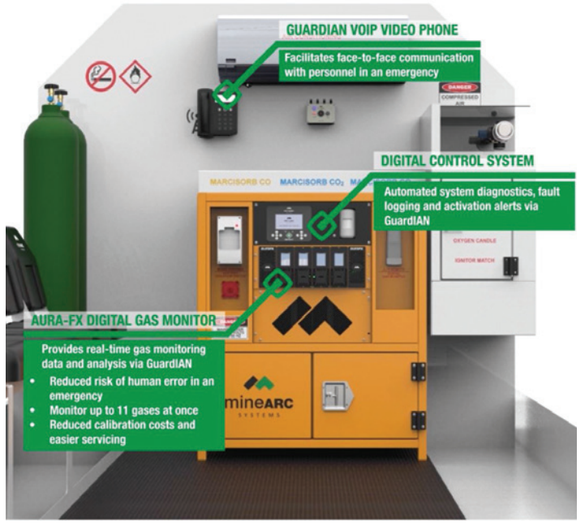


Chamber Integrity Monitoring

The Compressed Air Management System (CAMS) communicates vital information relating to the integrity of the internal refuge chamber ia 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 Series IV Digital Controller links directly to the GuardIAN Network, streaming real-time system data, including automated system checks, fault logging (battery, scrubber, temperature and inverter), system diagnostics, internal and external temperature measurements, and system actions such as scrubber activation.

MineARC's Aura-FX also provides real-time gas monitoring data and analysis via the GuardIAN Network dashboard.

Live Video Monitoring and 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 mining environment, GuardIAN Connect uses a single coaxial cable to carry both power and data.

Chamber Exterior Rear

A secure cabinet at the rear of the MineSAFE 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 mine power become cut-off.

The Compressed Air Management System (CAMS) allows regulated compressed air into the refuge chamber when the pressure inside drops below 200Pa. This process optimises mine air usage and guarantees against over-pressurisation of the refuge chamber. CAMS' gas toxicity monitor automatically diverts compressed air if oxygen levels in the airline fall below a set level (18% oxygen in free air), signifying air contamination. Additionally, the incorporated flood protection valve automatically shuts down compressed air to avoid catastrophic and costly chamber damage in the event of water ingress.

Feature Summary

MS-ED2-12-ELV-36

- 8-30 Person Occupancy
- Manoeuvrable Design
- Narrow Shell for Tight Confines
- 5mm (1/4") Steel Plate
- CO and CO_2 Scrubbing
- Breathable Air (O_2) Supply
- Air Conditioning
- 36 Hours Battery UPS
- Extra-Low-Voltage Controller

Standard Features

- 5mm (1/4") steel plate construction
- Blast rating: 5psi
- CO & CO_2 scrubbing
- Pre-packaged chemical cartridges
- Advanced extra low voltage control system
- 2 x sources of breathable air (O_2) supply
  - CAMS
  - Medical oxygen cylinders
- Air conditioning and dehumidifying
- Aura-FX Digital Gas Monitoring System
- Battery backup (UPS) 36hrs standalone
- Side escape hatch with internal/external access
- Viewing porthole
- Stainless steel fittings throughout
- Ergonomically designed seating
- Lifting lugs, skid base and forklift slots
- Emergency food and water rations
- Fire extinguisher (optional for International)
- Fire blanket
- Chemical toilet

Optional Features

- Special dimensions and transport configurations available
- Fully flushing, pressurised airlock
- GuardIAN Remote Monitoring & Diagnostics
- Satellite UPS System
- Battery backup UPS upgrade to 48, 72, 96hrs
- First aid kit (standard on US models)
- Step-down transformer
- Receptacle plug (trailing cable connecting plug)
- Blast shield protection (reinforced construction), upgradable to withstand percussion blasting
- Blast rating upgrade

Optional: Satellite UPS System

MineARC's Satellite UPS System 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/systemintelligence**

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.

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