

Reducing Machine Hazard Exposure to Workers Underground

Presented by
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The Real Occupational Hazards Underground Workers Face

Thermal Exposure



Diesel Particulate &
Gaseous Emissions



Continuous High
Noise Environments



These hazards are constant underground, and their effects build with every shift.

Operating Underground in Ontario Today



As Ontario production increases, equipment runs longer — and exposure compounds across every shift.

\$15.7B mineral production (2023):
50% higher than a decade ago

Shifts exceeding 8 hours: Longer
exposure windows

Diesel limit: 0.12 mg/m³ EC

Noise benchmark: 85 dBA Lex, 8

**Sustained Intensity × Extended Duration =
Increased Worker Exposure**



Thermal Exposure & Burn Risk

High-temperature equipment operating in confined environments elevates worker risk.

Fire Risk in Confined Mining Environments

Diesel equipment operates at extreme temperatures

Exhaust manifolds and turbos reach several hundred °C

Workers operate in close proximity underground

Confined access increases accidental contact risk

Fire Escalation Factors Underground

Hot surfaces near fuel and hydraulic systems create ignition risk

Fluid leaks contacting hot components can ignite

Smoke spreads quickly in limited egress spaces

Fires trigger evacuation, downtime, and production loss



Fire & Burn Risk Reduction Solutions

Dual wall exhaust systems and thermal insulation act as PPE for the machine, controlling heat at the source before worker exposure occurs.

Dual-wall Exhaust Systems

- Isolate high-temperature exhaust gases, lowering exposed surface temperature and reducing ignition risk.

Insulated Blankets And Thermal Covers

- Removable thermal blankets, metal guards, and shields contain heat on turbos, manifolds, and exhaust systems.
- Maintain safer surface temperatures while reducing burn risk and secondary fire potential.

Personal Protective Equipment (PPE)

- Provides protection during normal operation, inspection, and maintenance where proximity to heated components cannot be fully eliminated.



Hot surface benchmark: Many fluids can ignite around 211°C. Therefore, exposed equipment surfaces should remain below 150°C.

Airborne Hazard Exposure Underground

Exposure is continuous across the shift, not isolated events.

What Is in the Air

Diesel particulate matter (DPM)

Nitrogen oxides (NO_x)

Carbon monoxide (CO)

Unburned hydrocarbons

What the Image Shows

Particle size determines how deep contaminants travel in the body.

Larger particles are trapped in the **nose and throat**.

Smaller particles move into the **lungs and bronchial tree**.

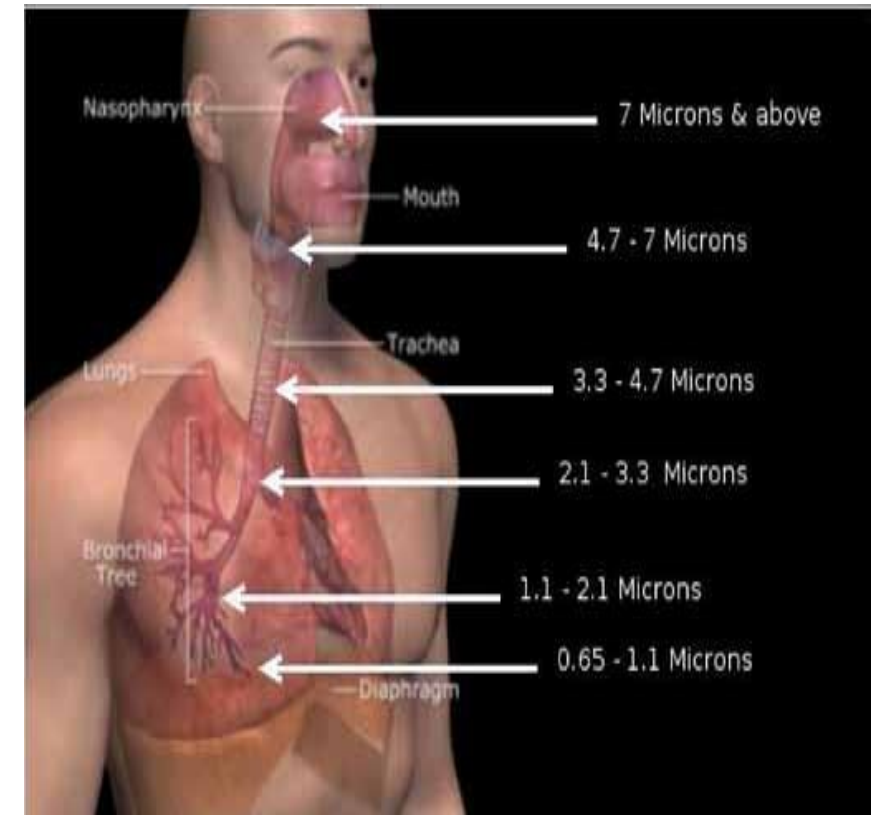
The smallest particles reach the **deep lung tissue**, where they can remain and accumulate.

Diesel particulate is often in these **small respirable sizes**

Why It Matters

Exposure builds every shift and increases long term respiratory risk for underground workers.

During fire events, additional combustion toxins are released and concentrated in confined headings.



Improving Air Quality Underground



Reducing airborne hazards and exposure for worker health.

Ventilation Expansion

- Dilutes contaminants but requires significant capital and structural modification.

Electrification / Battery Equipment

- Eliminates combustion emissions through fleet transition.

Retrofits and Aftertreatment (DPF / SCR)

- Reduce diesel particulate and NOx at the engine source; effectiveness depends on complete soot burn cycles and disciplined maintenance.

Operational Controls

- Personal DPM monitoring and idle / machine runtime management.

PPE

- Provides respiratory protection where exposure cannot be fully engineered out.



Noise as a Compounding Hazard

Persistent high noise exposure drives fatigue and reduces situational awareness.

When You Can't Hear, You Can't React

The 8-hour action level is 85 dBA (Lex, 8).

Underground equipment commonly operates between 98–110 dBA.

Every 3 dB increase doubles sound energy.

110 dBA represents dramatically greater exposure than 95.

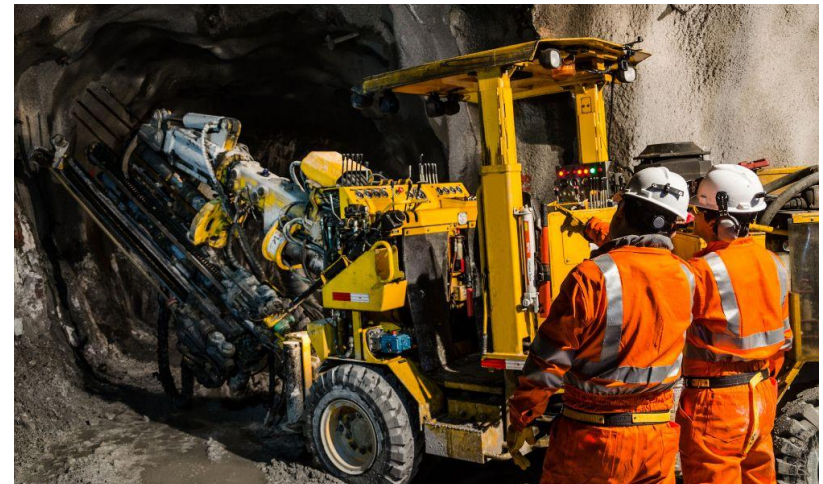
What Happens Across the Shift

Noise persists for 8–12 hours.

Communication becomes strained.

Alarm recognition weakens.

Fatigue builds.



Source Level Noise Mitigation



When noise goes down, communication and awareness go up.

Exhaust Attenuation and Muffler Upgrades

- Reduce noise at the source on mobile equipment
 - Lower emitted dBA levels directly from the exhaust system.
 - Typical upgrades deliver **10 to 15 dBA reduction**, significantly lowering total sound energy exposure.

Why Source Control Matters

- Reducing noise at the machine improves **communication and situational awareness underground**.
- Engineering controls reduce reliance on **double hearing protection** that can isolate workers.

Real Underground Example

After replacing a failed muffler, an operator told us:

“I can finally hear my radio again.”

That is not comfort.
That is **situational awareness restored**.



Integrated Risk Reduction

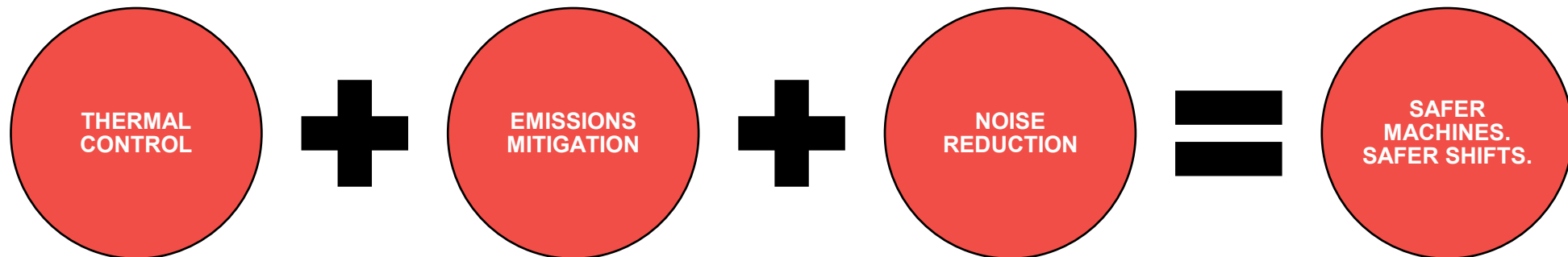
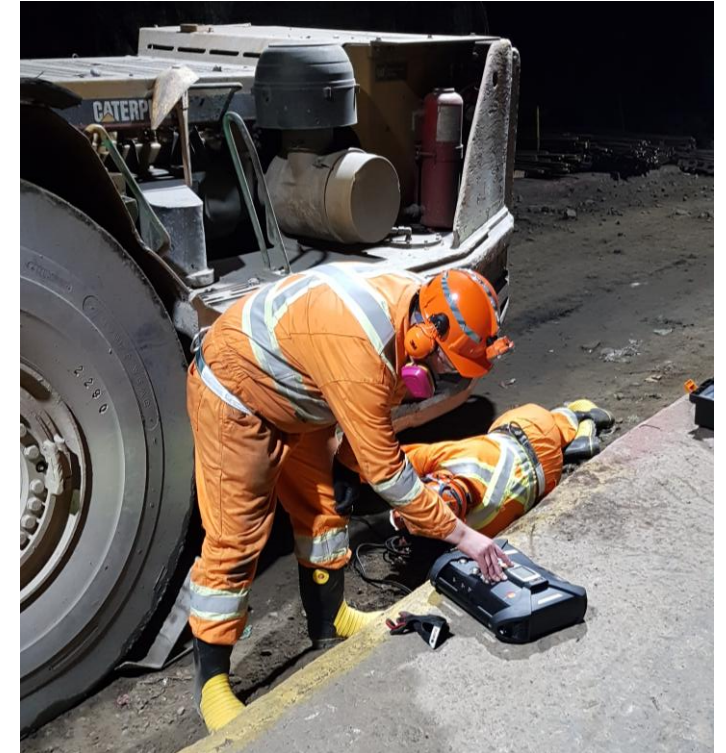
Reducing hazard intensity decreases cumulative exposure.

Reducing **any one hazard** improves working conditions underground.

- Lower surface heat reduces burn and ignition risk.
- Lower diesel particulate improves air quality and respiratory exposure.
- Lower noise improves communication and alertness.

Together they reduce cumulative worker exposure across the shift.

Ensuring workers getting home safely, every day.



We Make Machines Safer

Mammoth provides engineered solutions that address underground hazards directly at the source.

Thermal Control

- Dual-wall exhaust systems
- Removable thermal covers

Emissions Mitigation

- Diesel emissions retrofit systems
- Aftertreatment solutions

Noise Reduction

- Exhaust system upgrades
- Muffler improvements



Because the goal of every shift is simple.
Everyone goes home safe.

Who we work with



CATERPILLAR



VALE



Newmont



**SMS
EQUIPMENT**



Canadian Natural



KINROSS



Teck



SUNCOR



GLENCORE



Peabody



TOROMONT



**NEVADA
GOLD MINES**



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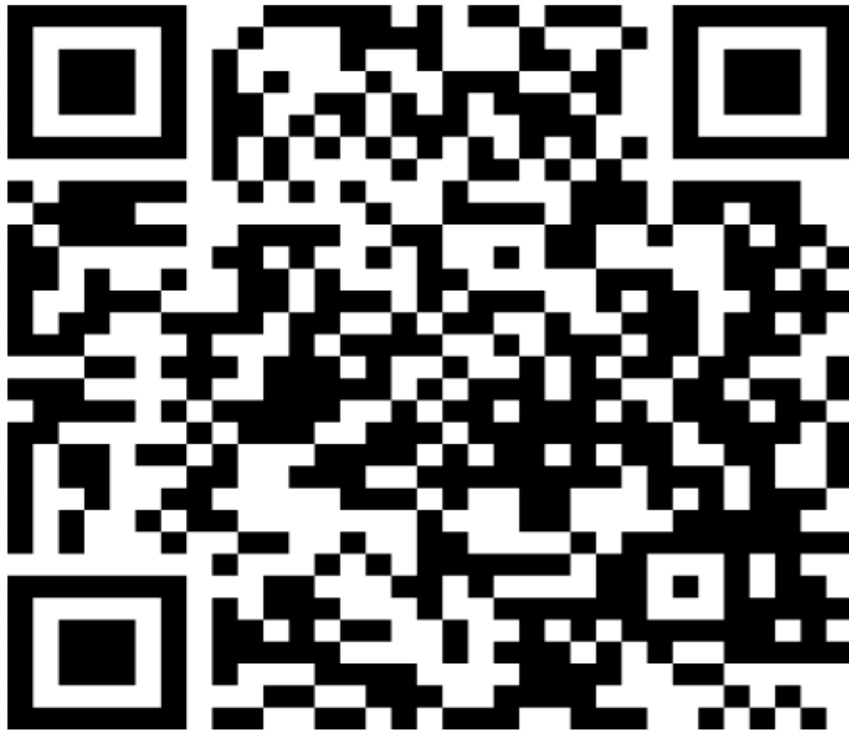
**Navajo Transitional
Energy Company**



Barrick

Share your thoughts on Machine Safety (2 minutes!)

Which machine-related hazard concerns you most right now?



<https://bit.ly/machinesafetysurvey>



Prize Value: \$1600

SUBMIT TO WIN!

Thermal Imaging Camera to identify heat hazards on-site