



Proximity Detection & Collision Avoidance

Strata's solutions for surface, underground, and surface-to-underground





HazardAVERT®

Proximity Detection & Collision Avoidance

Strata has many years of R&D and extensive industry experience. Working closely with operation managers and personnel around the world, the company continues to expand and enhance its safety technologies.

HazardAVERT®- Near-field electromagnetic detection, alarm and intervention system for use in surface and underground industrial work sites.

HazardAVERT® is an electromagnetic proximity detection system (PDS) and collision avoidance system (CAS) implemented to increase worker safety and safety awareness while working in and around mobile machinery. HazardAVERT® is designed for industrial environments such as mining, tunneling and construction to prevent accidents involving machinery.

- **Machine-to-Machine**
- **Machine-to-Person**
- **Machine-to-Stationary Equipment or Structure**
- **Perimeter Guarding**
- **Geofencing**

HazardAVERT® has been effectively used on all types and sizes of mobile machinery and vehicles and is OEM agnostic.

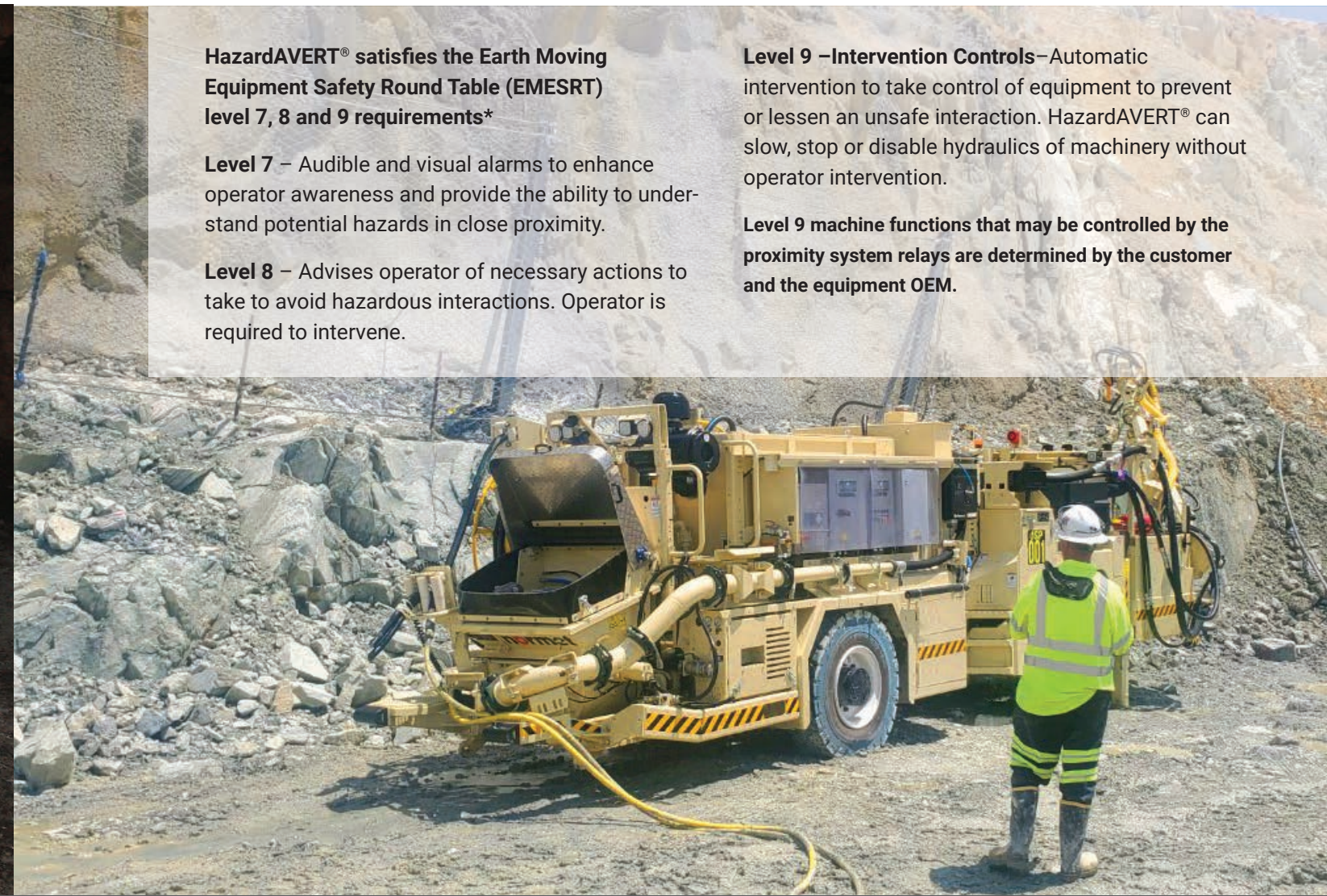
HazardAVERT® satisfies the Earth Moving Equipment Safety Round Table (EMESRT) level 7, 8 and 9 requirements*

Level 7 – Audible and visual alarms to enhance operator awareness and provide the ability to understand potential hazards in close proximity.

Level 8 – Advises operator of necessary actions to take to avoid hazardous interactions. Operator is required to intervene.

Level 9 – Intervention Controls–Automatic intervention to take control of equipment to prevent or lessen an unsafe interaction. HazardAVERT® can slow, stop or disable hydraulics of machinery without operator intervention.

Level 9 machine functions that may be controlled by the proximity system relays are determined by the customer and the equipment OEM.



* Refer to: Earth Moving Equipment Safety Round Table PR – 5A Vehicle Interaction Systems (EMESRT PR-5A Vehicle Interactions_v2_20190902.pdf)



USER EXPERIENCE & SYSTEM FEATURES

- Seamless implementation into operations.
- Does not interfere with production
- Surface and underground use
- No line-of-sight required
- Penetrates rock, coal, gravel, mud, water, ventilation curtains and barriers
- Unaffected by light/visibility, weather conditions, airborne debris
- Monitoring and reporting capabilities

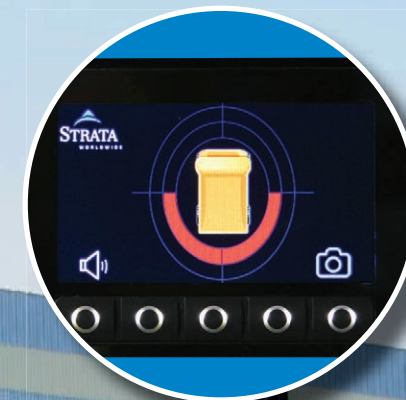
HazardAVERT[®] System Components

How do the components work together?

Display Screen installed in driver's cab



Proximity Generator installed on machinery

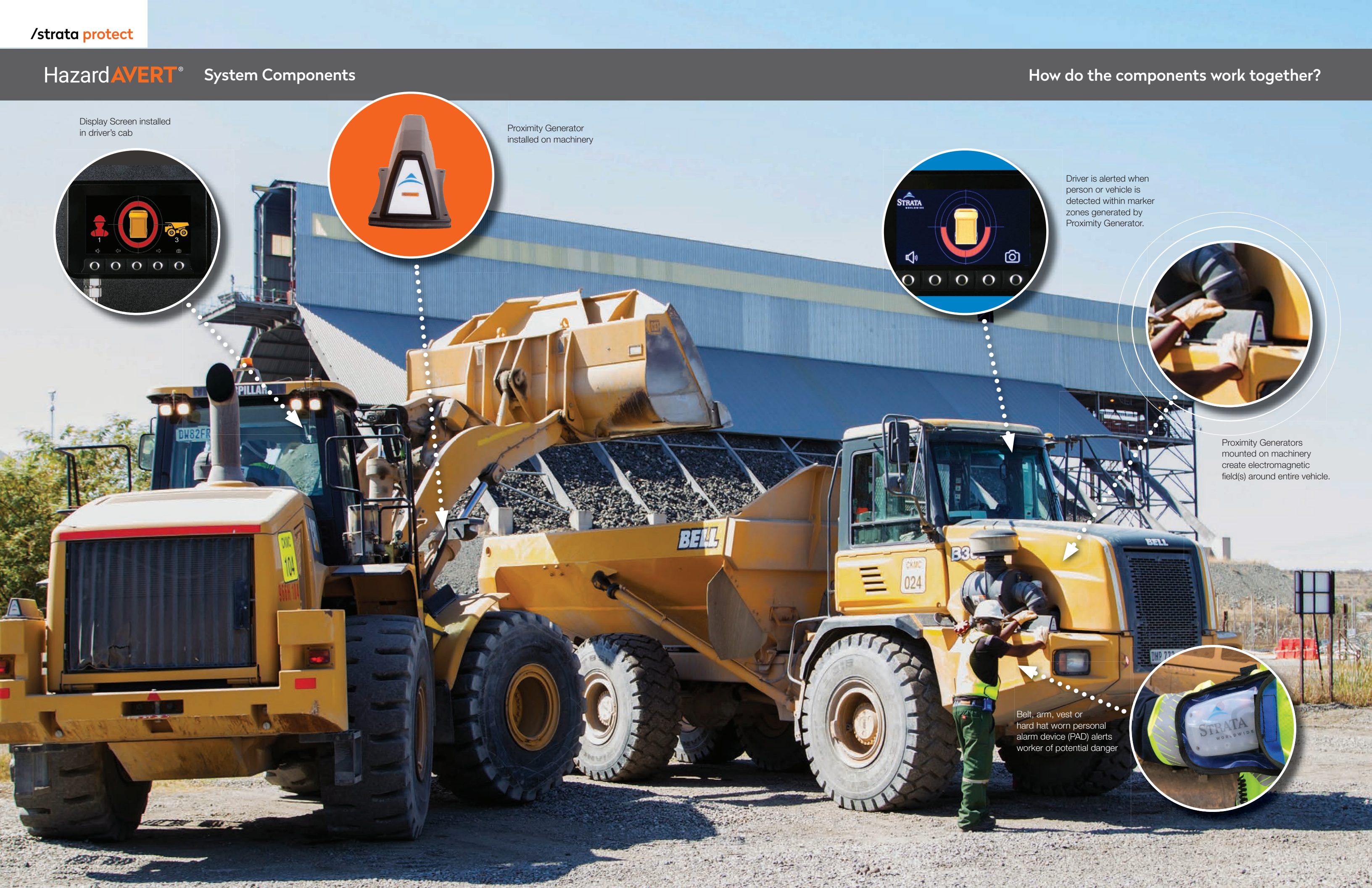


Driver is alerted when person or vehicle is detected within marker zones generated by Proximity Generator.



Proximity Generators mounted on machinery create electromagnetic field(s) around entire vehicle.

Belt, arm, vest or hard hat worn personal alarm device (PAD) alerts worker of potential danger



Electromagnetic warning and hazard zones-generated by HazardAVERT® Generators

- High resolution 360° coverage around equipment
- Functions both on the surface and underground
- Stable, reliable and repeatable
- Capacity to function with all vehicles and people in close proximity without latency or delay

Personal Alarm Devices (PADs) and Vehicle Alarm Devices (VADs) are HazardAVERT® receivers. These detect the zones, determine level of danger based on distance, and trigger warning alarms with intervention responses as applicable.

**Level 9 Machine functions that may be controlled by the proximity system relays are determined by the customer and the equipment OEM.*

SILENT ZONE

Exclusion area within hazard zone to enable operators to work on machinery without triggering the system. As soon as operator exits the silent zone, the hazard zone will be triggered.

WARNING ZONE

Outer zone. A breach triggers audible and visual warnings on individual PADs and vehicle display screens simultaneously. Vehicles with level 9 interfacing will automatically slow/crawl without operator Intervention.

HAZARD ZONE

Inner zone. A breach triggers audible and visual alerts on individual PADs and vehicle display screens simultaneously. Vehicles with level 9 interfacing will automatically stop without operator Intervention.



HazardAVERT®

VEHICLE DISPLAY AND ALERTS

HazardAVERT® Display Screen

Display screen for system operating status, machine operator interface, maintenance and diagnostics. Screen displays zone breaches, warning alarms and camera feeds.

- CAN Bus capabilities
- Wi-Fi – Monitoring & Reporting (see page 10)

AUDIBLE WARNING ALARMS FOR MACHINE OPERATOR

- Alert operator of field breaches - warning or hazard zone
- Differentiation between equipment versus person breach
- Customize machine interactions

- Allow additional field configuration and more dynamic field thresholding

Optional Cameras

- Front and/or back mounted wide-angle-lens cameras
- Live feed to HazardAVERT® Display Screen
- Operable depending on direction of travel



Five-inch display screens for system maintenance, diagnostics and operating status and serves as the operator interface and warning device. Screen displays zone breaches, level of alarms and camera feeds.



HazardAVERT® PERIMETER GUARD

Perimeter Guard proximity detection uses a cable to generate linear electromagnetic fields and create invisible fencing around restricted areas and work zones, or safety barriers along berms and around equipment.

Custom sized warning and hazard zones along the cable are detected by HazardAVERT® receivers worn by personnel (PADs) and installed on vehicles (VADs). These provide proximity warning alerts or initiate automatic intervention controls to stop moving equipment in an emergency.

Perimeter Guard provides EMESRT level 7, 8 and 9 capabilities.

Safety zones around equipment:

- **Mark off designated areas**
 - Used to create permanent or temporary restricted areas, safety zones, lunch areas or work zones underground
 - Designed to keep machinery and vehicles from entering the protected area
 - The system can be programmed to slow or stop machinery if the zones are breached

- **Conveyor belts and bridge conveyor systems**

- Installed along the length of the conveyor to ensure personnel stay at a safe distance while belt is operating
- Eliminates unsafe practices around conveyors
- Works to prevent collisions from nearby mobile machinery
- Belt can be programmed to stop automatically

- **Continuous haulage system**

- Installed along the length of the system to ensure operator remains in a safe working position away from moving components and wheels
- Equipment and belt can be programmed to stop automatically

- **Safety berms**

- Placed along the berm to provide early audible and visual warning as machinery approached the edge
- Machinery can be programmed to stop before entering an unsafe location

- **Feeder breakers and crushers**

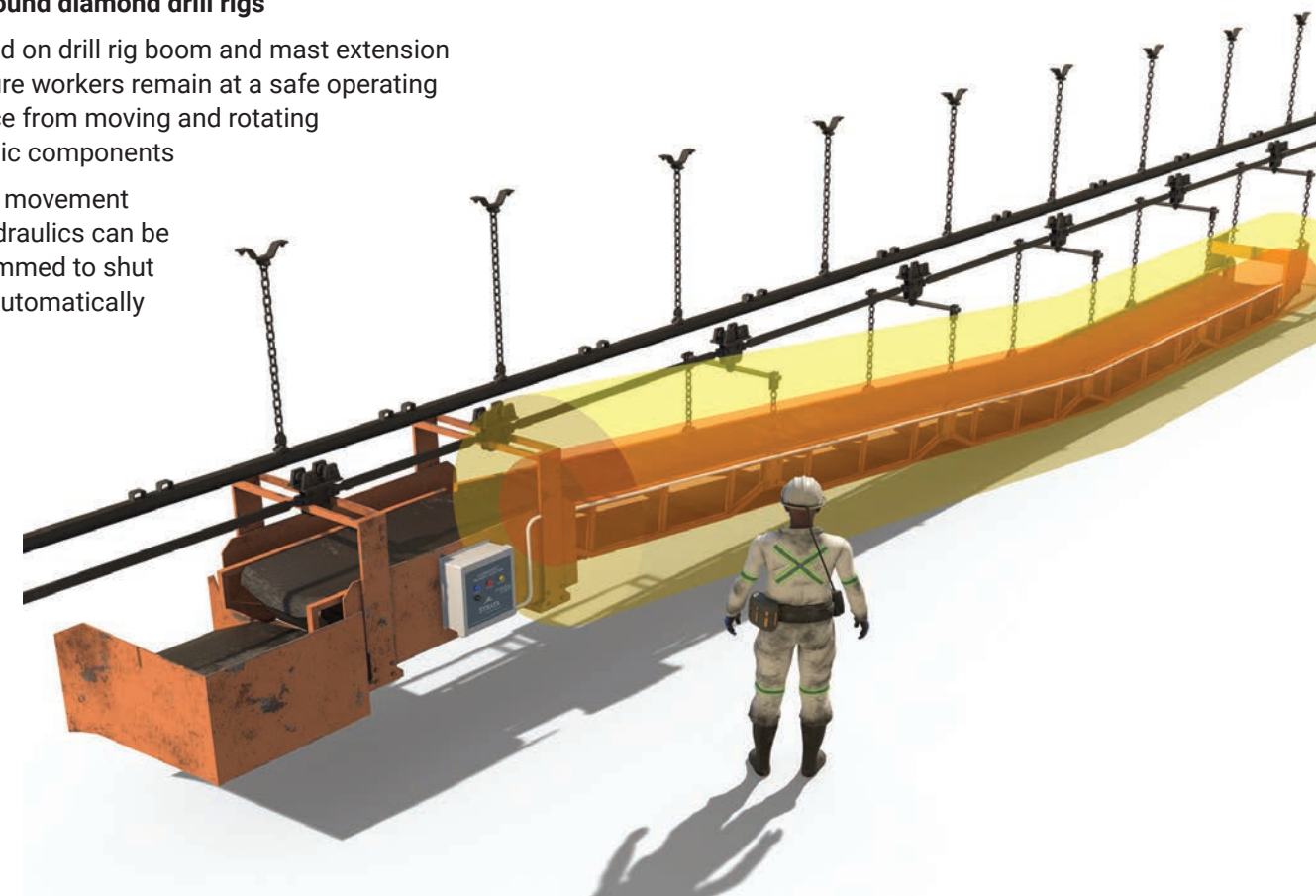
- Looped around equipment to prevent close advancement of workers on foot, or unsafe practices that can result in injury
- Chains, belts and crushers can be programmed to stop automatically

- **Underground diamond drill rigs**

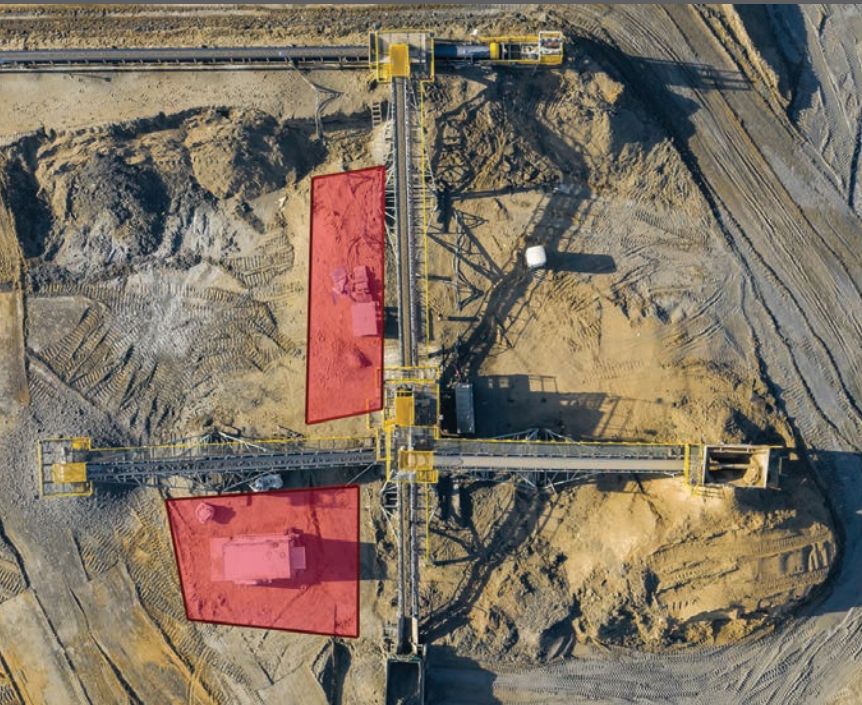
- Installed on drill rig boom and mast extension to ensure workers remain at a safe operating distance from moving and rotating hydraulic components
- Drill rig movement and hydraulics can be programmed to shut down automatically

- **Underground scraper winch**

- Installed in a loop through the gully to detect personnel when the winch operator activates the winch system
- If a person wearing a PAD is present in the gully, the system will alert the operator and will not initiate



HazardAVERT® GEOFENCING



- Virtual perimeter for the creation of permanent or temporary restricted areas, safety zones or designated work zones
- Designed to keep machinery and vehicles from either entering or exiting a specified area
- The system can be programmed to automatically slow or stop machinery if the zones are breached
- Restricted areas established for specifically trained and certified staff
- Provides record of unauthorized personnel entering area
- Record of activities and hazard zone breaches provide support for safety training and incident reporting

HazardAVERT® MONITORING & REPORTING

HazardAVERT® Monitoring and Reporting

All system events are logged and recorded. This data can be downloaded for analysis and reporting. In underground applications, the data can be transmitted over open standard Wi-Fi or StrataConnect 900MHz wireless mesh. In surface applications data can be downloaded and reviewed in real-time via Wi-Fi or LTE.

StrataConnect GUI features and capabilities

- Individual facility mine-map
- Easy view navigation with layers and tabs
- Ability to monitor at system level or zoom in to individual people and equipment
- High resolution tracking including direction of travel
- Personnel tracking
- Asset tracking
- Critical safety data reports
- Productivity trends
- HazardAVERT® system operating status and maintenance
- Mining equipment operating status and maintenance

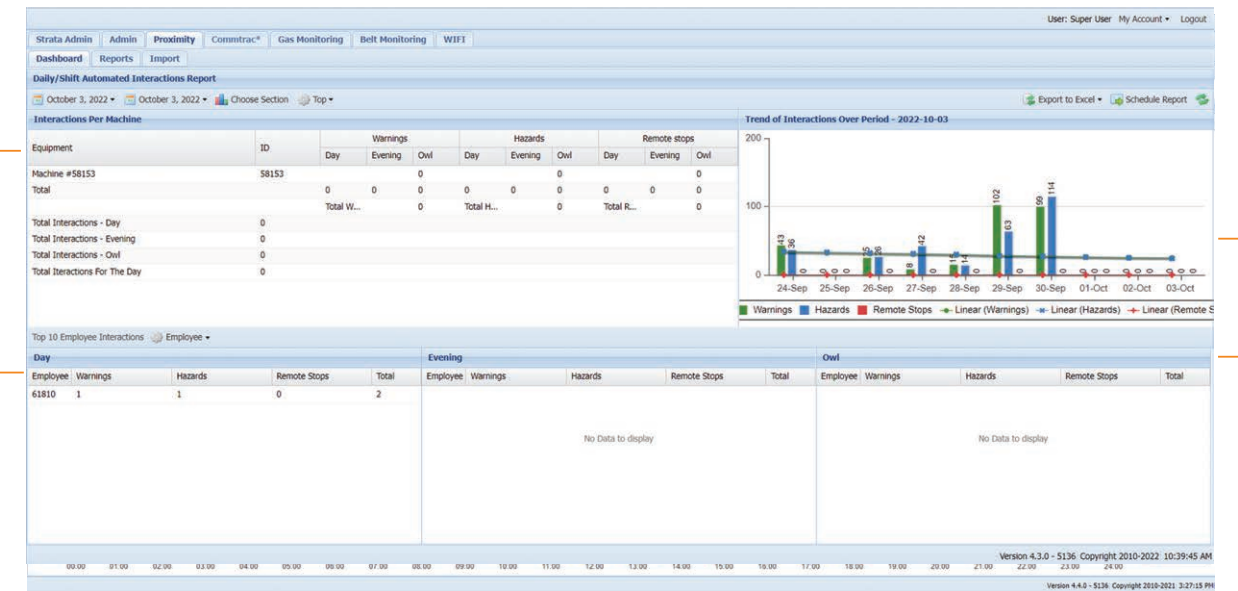
MONITOR

- Working & safety practices of personnel
- Worker and machinery interaction
- Warning and/or Hazard zone breaches and duration of breach
- Emergency, Hazard Zone breaches and/or stops
- Duration of inactivity
- Damage to components

REPORTING

- Safety Reports
 - Worker and machinery operator safety practices
 - Zone breaches – frequency and duration
- Productivity reports
 - Machinery tracking
 - Travel time
 - Stop time
 - Interactivity time

HazardAvert interactions per Machine. View by day/week/month

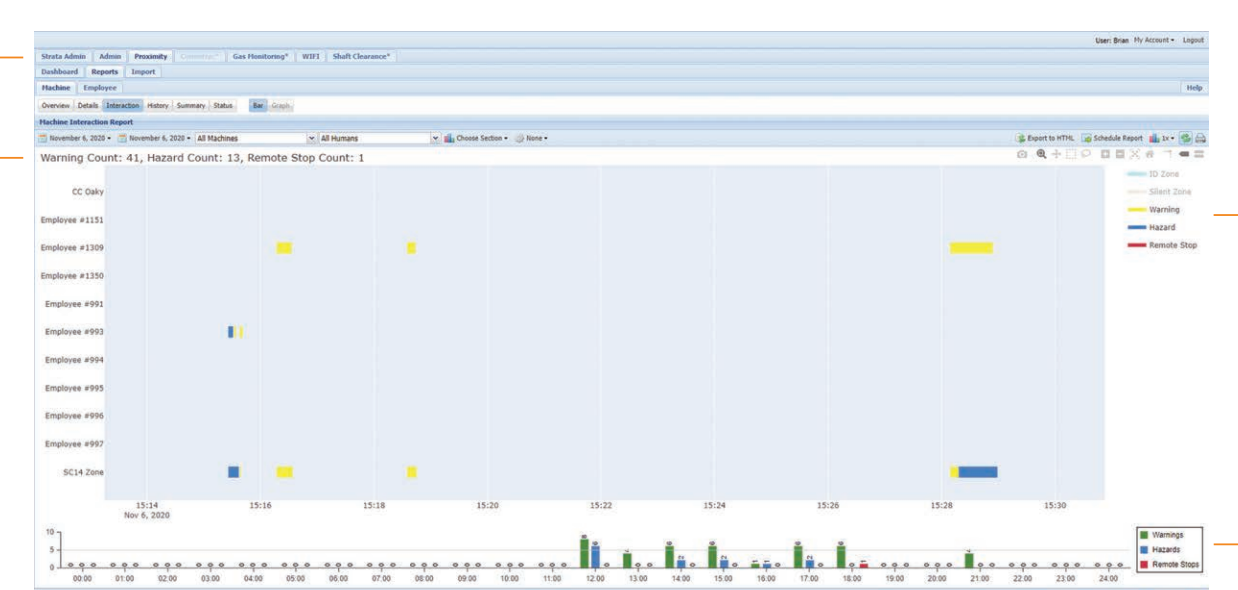


Data graph to review Trend Reports

HazardAvert interactions per Employee. View by day/week/month

Employee activity by shift

Multi-layered interface to toggle between system displays and reports



HazardAVERT interactions per employee, by time of day.

Summary of all activities

Summary of all activities by time of day

/strata **protect**

**HazardAVERT[®] Sees What
People Can't, and Reacts
When People Don't.**

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MINING

AMERICAS

8800 Roswell Road, Suite 145
Sandy Springs, GA 30350 USA
TF: 800-691-6601
T: 770-321-2500
F: 770-321-2520
info@strataworldwide.com

www.strataworldwide.com/mining