

CM311 Proximity Detection System Trial

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The Journey so far....

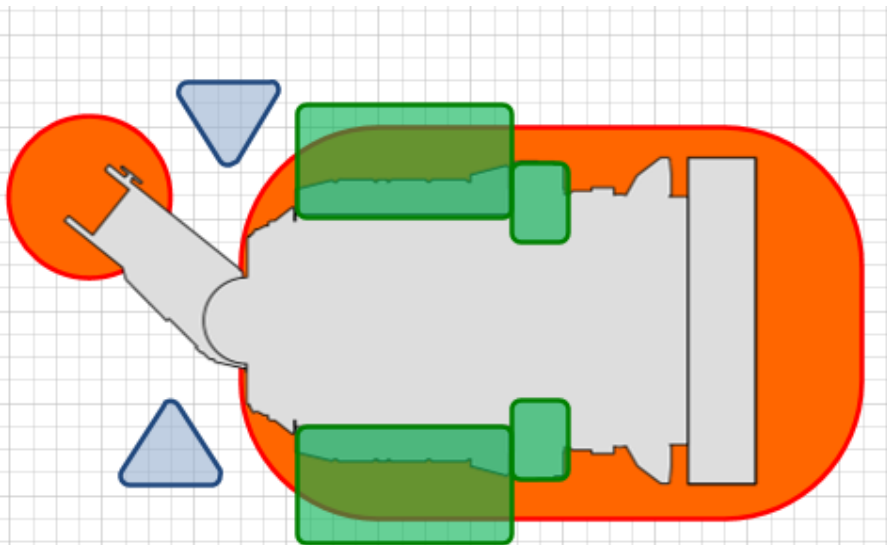
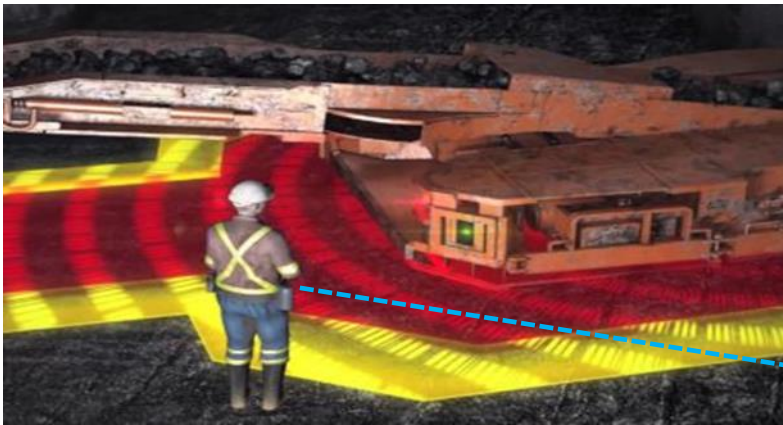
- **2021** – Consistent with longer term Proximity Management program, Centennial decided to trial a proximity detection system on a continuous miner in a production environment after an incident where an employee was seriously injured by a continuous miner boom.
- **2021/2022** – CM311 (Joy 12CM12 Bolter Miner) was overhauled incorporating the Centennial Mode Lighting Standard and was also fitted with both the Hardware and software to Trial Strata Technologies Hazardadvert Proximity Detection System.
- **August 2022** – Surface commissioning of the system commenced onsite at Myuna and so the learnings began.
- **February 2023** – Have not started the formal UG Trial due to an issue with repeatability.

The Journey so far....

This presentation will detail a practical trial of this technology in a production environment, outline hurdles that encountered and how they have been managed, and also detail the current issue impacting the trial which will be critical to the outcome.



System Requirements



- The application of a system at Myuna (and within Centennial) is different to longwall operations due to the mining systems in place.
- In this application the CM Operator will stand behind the platform during some parts of the cycle and the controlled safe area between CM platform, the rib and the conveyor boom is limited.
- To date this has been managed through No Go Zones, training, procedural controls, complemented more recently by Mode Lighting to clearly indicate which mode the Miner is in and whether it is safe to pass.

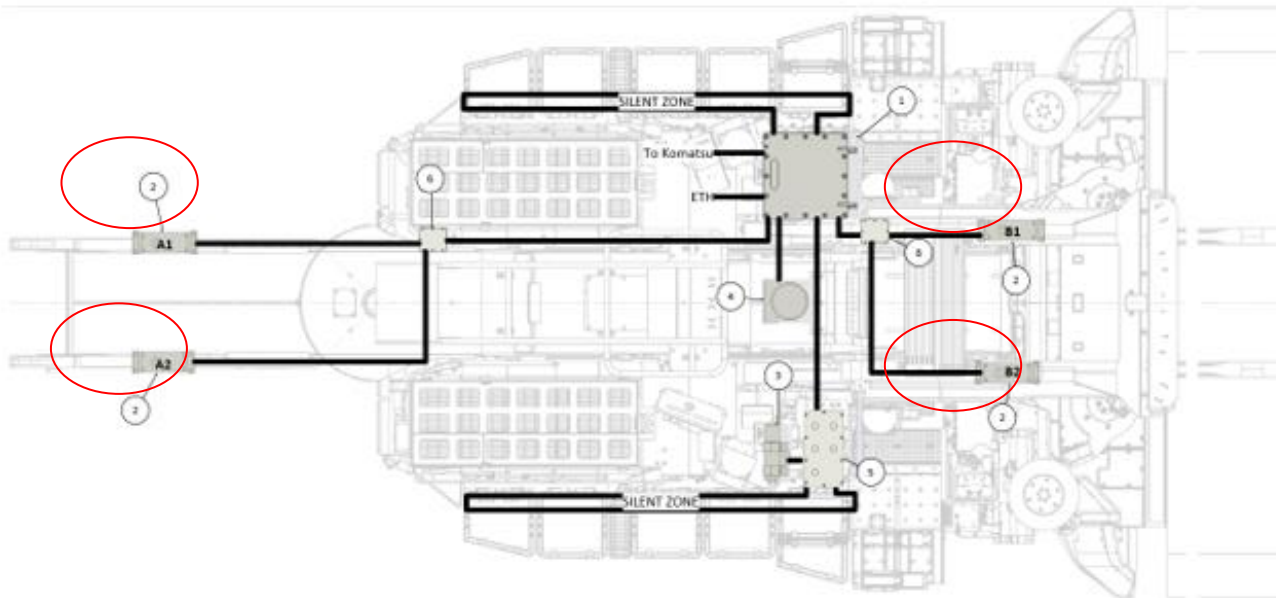


- Drivers Position in Plunge

System Functionality

Hazard Zones

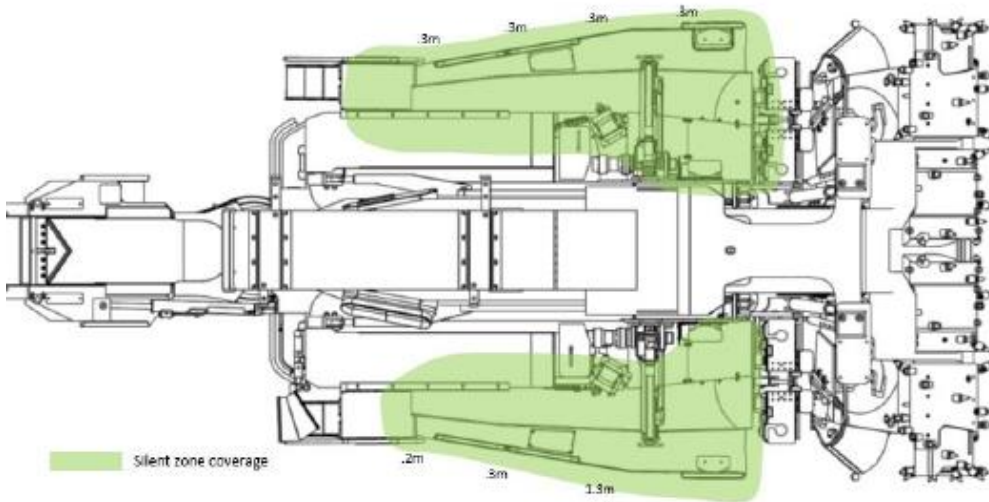
- The system utilises Four signal generators in specific locations on the CM to generate the required magnetic field shape that match our designated Hazard zones.
- All persons operating the continuous miner undertaking the trial will be wearing a modified cap-lamp that has a tracking pad fitted which will work with the generated magnetic field and stops the continuous miner if the cap lamp is detected in the Hazard zone.



System Functionality

Silent Zones

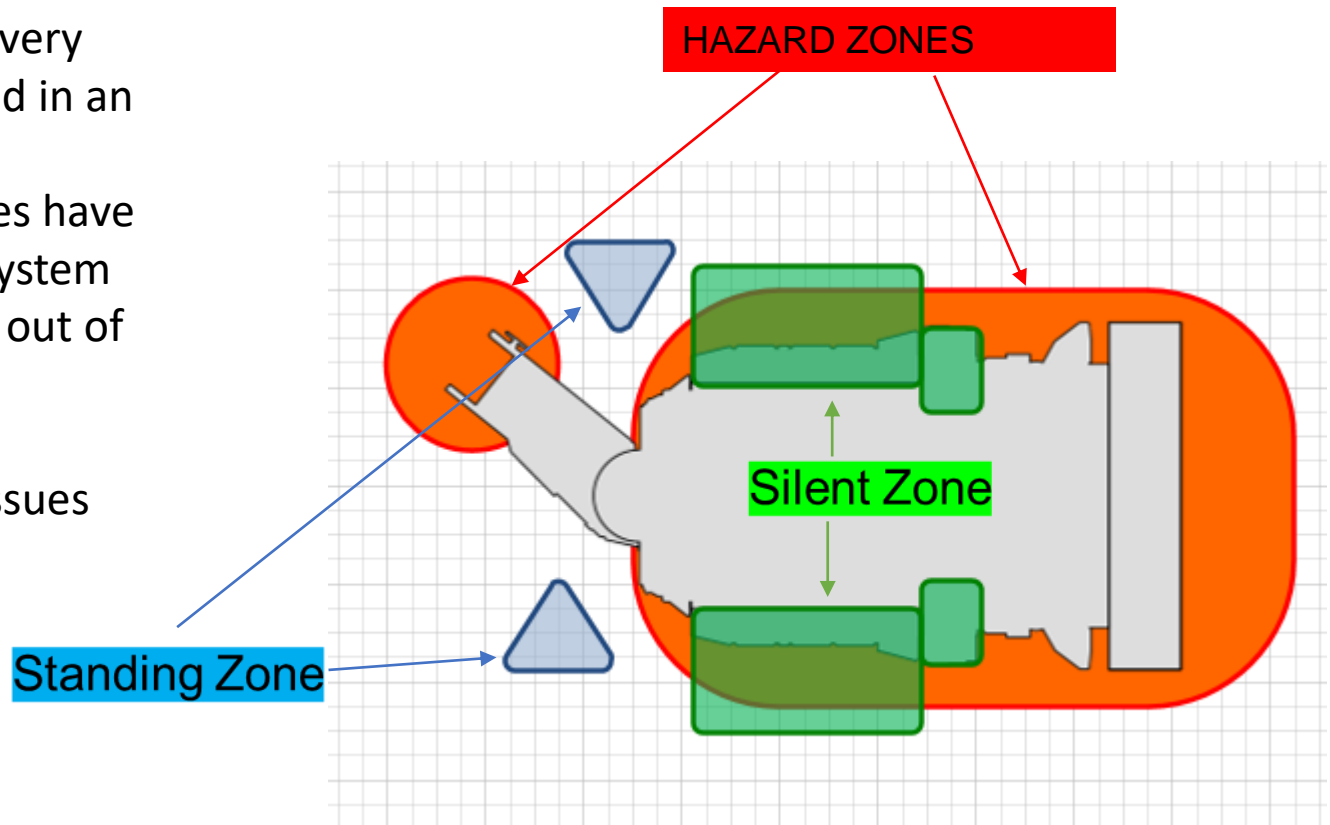
- Silent Zones are installed on either side platforms to allow operators to safely work during the mining process without activating the Hazard zone stop function whilst in Mining mode.



Zone requirements

- By using the Signal Generators and the Silent Zone in conjunction with the PAD's on the Cap lamps this is basic zoning required to operate the miner.
- To date zones achieved are very close to the area's as marked in an ideal workshop situation
- However, repeatability issues have been observed where the system only operates as required 8 out of 10 times on average.

Laurence will go through the issues encountered.





Proximity Detection System Commissioning

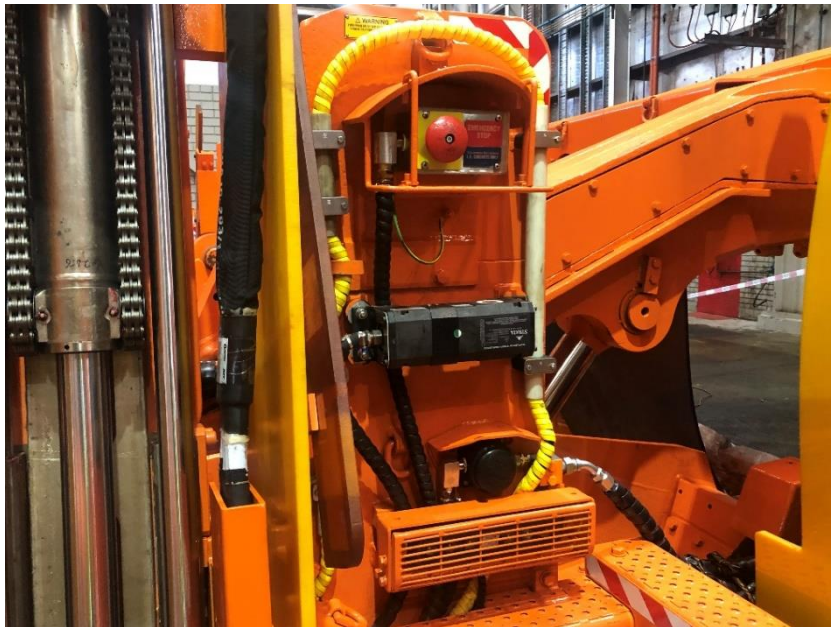
Learning opportunities Simulation Tunnel

- A mock heading was constructed to simulate an underground environment.
- Inconsistent stopping distances when flitting in, out, near the simulation tunnel. The frame was bolted to the concrete although acted like a Faradays cage.
- Due to this inconsistency, the simulation tunnel was not used.

Proximity Detection System Commissioning

Learning opportunities

- **Power output; too high**
 - When the original front generators (compact style) were installed the output power was set at 100% which created inconsistent tripping distances.
 - These generators were replaced with a different style, allowing the trip zone to be more consistent.



Proximity Detection System Commissioning

Learning opportunities

- **Power output; too low**
 - Rear generators output power was running at a level that was too low to maintain stability.
 - The rear generators were detuned to allow for a higher software power setting yet maintain the same tripping distance.



Proximity Detection System Commissioning

Learning opportunities

- **Silent Zone; sizing**

- The Silent Zone was too large and captured the corner of the CM. Modifications were made to the Silent Zone cabling which introduced issues of its own.
- Found small changes to cable reticulation has big effects on the shape and size of the Silent Zone.
- Therefore, if Silent Zone cabling is moved for maintenance or repair purposes the cabling will require re-positioning and silent zone re-commissioned.





Proximity Detection System Commissioning

Learning opportunities

- Steel interference
 - When mapping the trip zones around the CM found irregular pattern that coincided with the location of steel plates on the ground.
 - Initial trials UG has shown that steel roof support does not have a significant effect on detection zones

Proximity Detection System Commissioning Results

- **Underground**
 - Commissioning
 - Mining conditions include roof meshed and ribs bolted.
 - Results are as follows:

LEFT TO RIGHT		
TEST	STOPPING DISTANCE FROM TAIL	NOTES
1	Human and machine interaction then stopped	Mesh in rib near CM boom
2	300mm	
3	Human and machine interaction then stopped	

LEFT TO RIGHT		
TEST	STOPPING DISTANCE FROM TAIL	NOTES
1	~800mm	Cap lamp hung from roof mesh, but not secured therefore cap lamp rotating
2	~800mm	
3	Human and machine interaction then stopped	
4	Human and machine interaction then stopped	
5	~800mm	
6	Human and machine interaction then stopped	

LEFT TO RIGHT		
TEST	STOPPING DISTANCE FROM TAIL	NOTES
1	~800mm	Cap lamp hung from roof mesh and secured therefore cap lamp no longer rotating
2	~800mm	
3	~800mm	
4	Human and machine interaction then stopped	
5	Human and machine interaction then stopped	
6	~800mm	

RIGHT TO LEFT		
TEST	STOPPING DISTANCE FROM TAIL	NOTES
1	~300mm	boom swings noticeably slower right to left
2	~800mm	
3	~400mm	
4	~800mm	
5	~800mm	

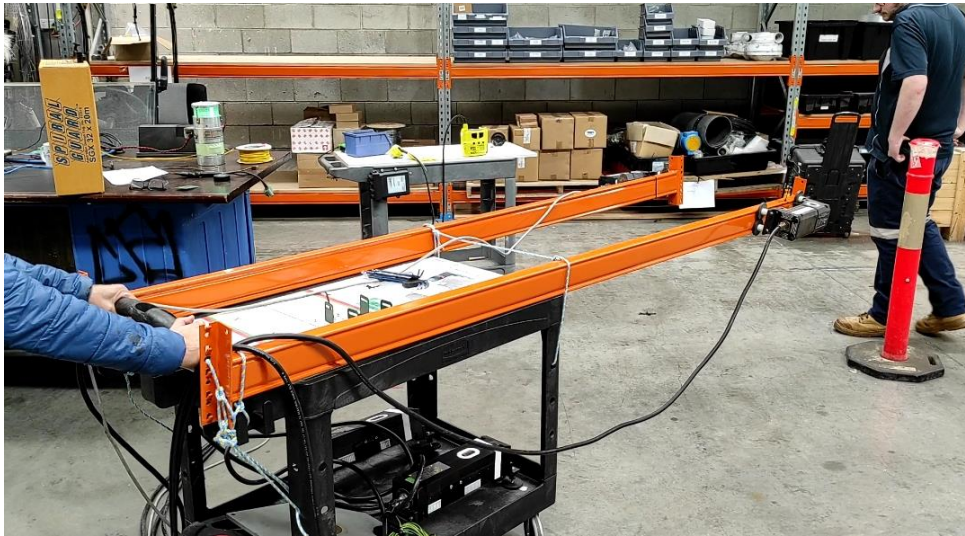
- The same tests were performed again with two (2) different cap lamps. With similar results, swinging both ways.

Proximity Detection System Commissioning

- Strata HQ

- Cap lamp investigation

- Strata then went through a rigorous testing regime in their workshop on the system with Myuna's modified Cap lamps and generators on a moving trolley as below with no obvious issues found.



Next step

Strata's plans going forward

- Testing has identified the system works correctly until the boom starts moving which supports an interference issue. This is likely from items such as solenoids, VFD's or other noise emitting hardware that is active during a boom swing. A series of tests will be conducted to ascertain the source of the interfering signal which may lead to the installation of Filters within the circuit.
- New firmware is being tested during February in the USA that better mitigates interfering signals. The PAD (alarm device on person) utilizes firmware optimized for maximum range, whereas this application requires very short range which can be modified.
- Cable used to connect the Generators did not use twisted pair (noise immunity) that may assist with the noise, pending the above tests, which they are predicting will address the reliability issue.
- What we don't want is a system that introduces complacency for the operators along with a system that isn't 100% reliable and therefore potentially adding another layer of hazard.





Key Points

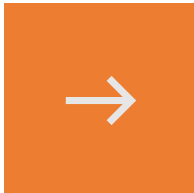
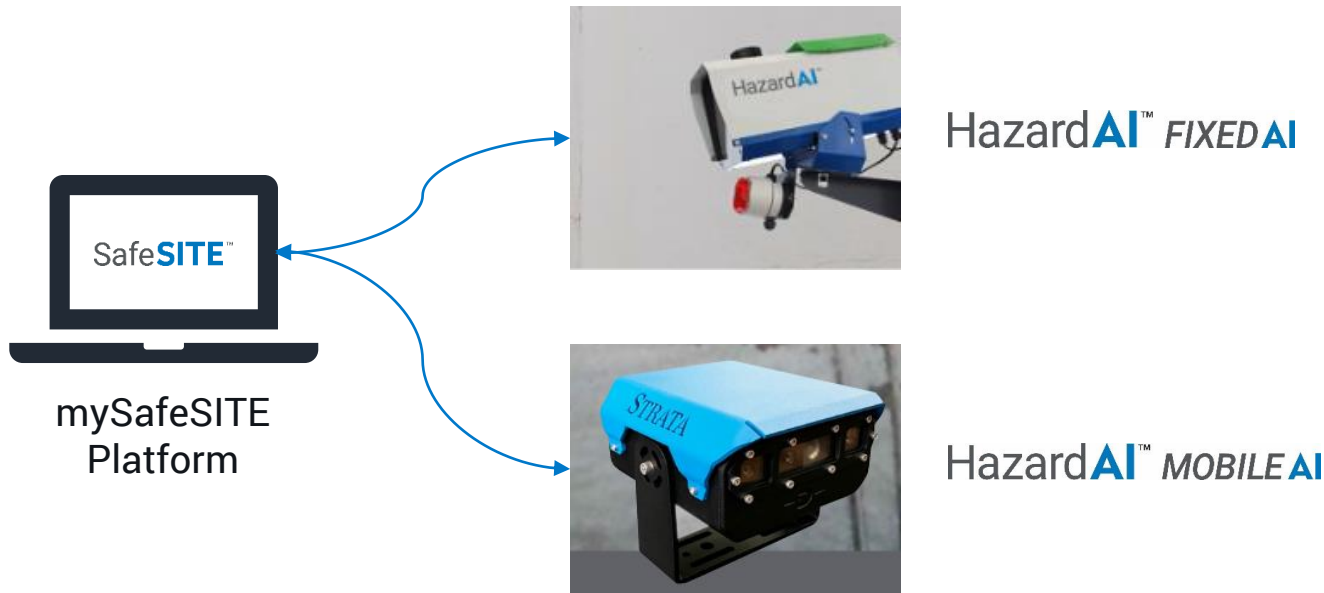
- Proximity Detection Technologies are available for Underground Coal applications
- However, as demonstrated in this presentation, these system require significant work and customisation to provide a reliable control to the risk of an equipment to person interaction. This is especially relevant where the mining method or application is unique, or sufficiently different from existing deployments of the technology.
- Over the last 6 months the Team at Strata Technologies and Centennial Coal have been working together to get this system to work in this application with the trial currently achieving 80% reliability. Which means ...
- Further work is required as 100% reliability must be achieved

The logo consists of a stylized white flame or leaf symbol to the left of the word "CENTENNIAL".

CENTENNIAL

/SafeSITE

Strata has two AI-vision field device families connected to an application platform



Products

HazardAI™ MOBILE AI
Collision Avoidance System



**NO RFID Tags required to
detect pedestrians**



- HazardAI – Machine vision (AI) system that detects and differentiates pedestrians, machines like ADTs, Dump trucks, Forklifts, Cars and other machines.
- HazardAI – Stereoscopic vision system to measure distance to the objects detected.
- HazardAI – Collision avoidance algorithms built-in.
- HazardAI – Automated warnings to operators.
- HazardAI – Reduces potential accidents with pedestrians and other machines

Products

HazardAI™ *FIXEDAI*

Detects pedestrian incursions
into exclusion areas



**NO RFID Tags required to
detect pedestrians**



- FixedAI technology monitors people entering exclusion zones
- Quick & Easy to install
- Sirens, verbal and email notifications activated when people enter exclusion zones
- Site managers track and analyse incident data for their sites through a comprehensive dashboard
- Remotely maintained and future feature upgrades through monthly subscription service
- Site can have safety conversations with real data
- FixedAI helps change behaviours with real time notification when people are in hazardous areas