



Proximity Detection Options on Komatsu Machines

Machines used in Coal Mines

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Komatsu's Historic Position

Within the Australian Marketplace

Komatsu's Historic Position

- Development / Room & Pillar Equipment
 - Komatsu does have a “Joy” branded PDS system called SmartZone for machines in the North American marketplace
 - SmartZone is sold as a training tool to educate coal mine workers where they should or should not be when machines are operating. It is specifically designed to meet the requirements of Mine Safety & Health Administration (MSHA), the Mine Regulators for the USA.
 - SmartZone is not available for sale in Australia. Komatsu has no plans to make this product available to Australia.
 - Komatsu has always been prepared to fit customer specified 3rd Party PDS systems to Joy machines with hardwired interlocks, where requested to do so by a customer
- Longwall Equipment
 - Due to the requirement for a PDS system to be able to detect a person on a specific roof support, Komatsu developed a “Joy” Branded system specifically for use with the RS20s/RS20n PRS control system known as a Personnel Proximity Detection (PPD)



Komatsu's Current Position

Within the Australian Marketplace

Komatsu's Current Position

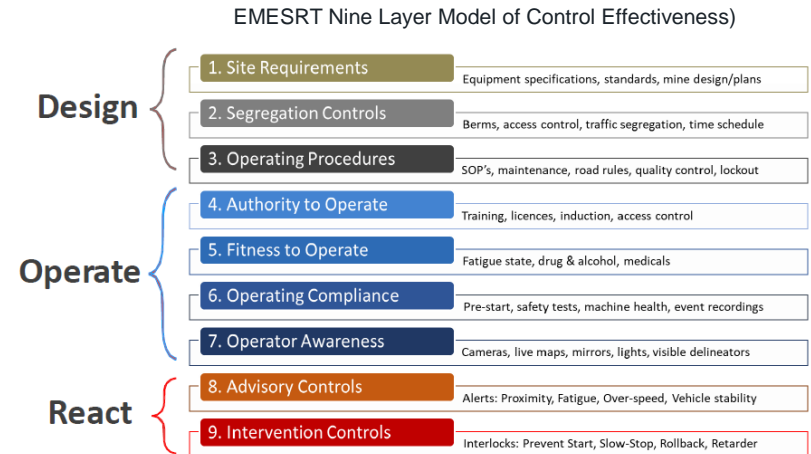
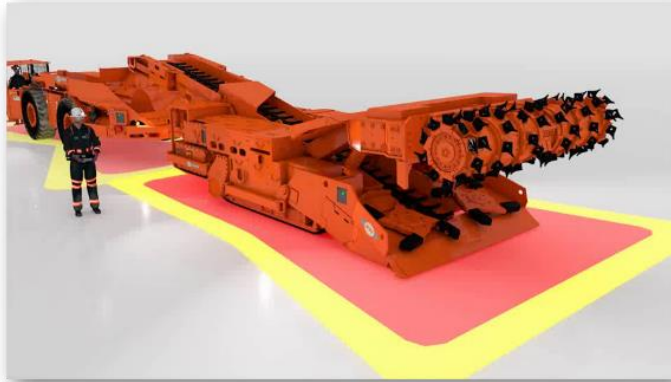
- Following the publication of the “Report into the serious injury of a worker at Myuna Colliery” (Ref: RDOC22/137062) in September 2022, Komatsu revised its position on PDS systems.
- Where PDS has been identified in the design risk assessment as a practicable control, Komatsu will now only supply new equipment for use in coal mines with a 3rd party PDS system fitted.
- The customer has the option to choose which system the customer prefers
- If the customer does not want a PDS system fitted to its machine, Komatsu require a statement indicating acknowledgement of Komatsu's position on PDS systems and that the customer has chosen to manage the risks a PDS system is designed to mitigate in an equally effective but alternative manner
- When overhauling a machine, Komatsu strongly recommends fitting a PDS system to the machine, however, the customer is the owner of that machine and may choose to not act upon this recommendation

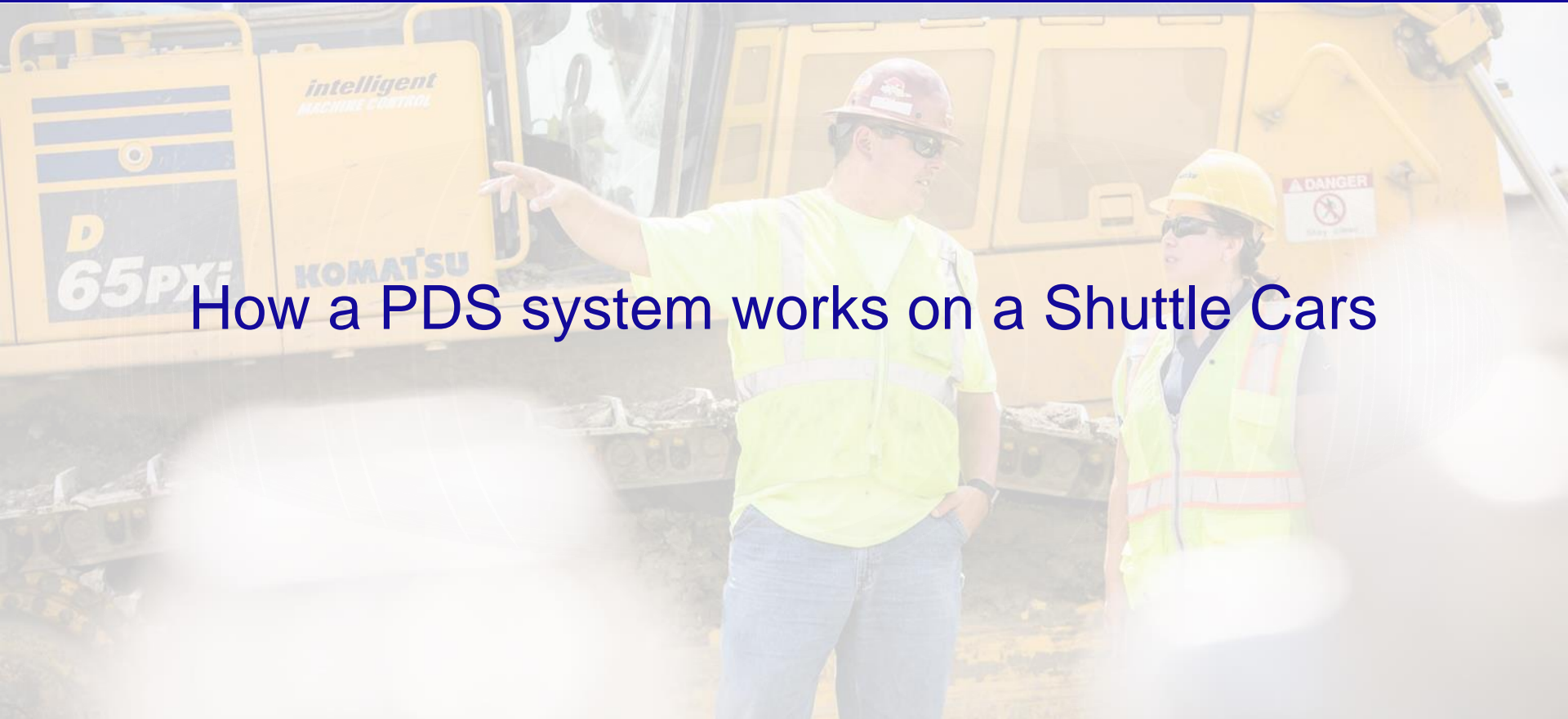


How do PDS systems work with Joy machines

PDS on Development Equipment

- Komatsu use a hardwired interface which provides a level of control as per levels 8 and 9 of the EMESRT Nine Layer Model of Control Effectiveness i.e., an initial advisory warning zone (shown in yellow), a direct intervention or “Stop” zone (shown in red)





How a PDS system works on a Shuttle Cars

PDS on Development Equipment – Shuttle Cars

- The hardwired interface provides the following inputs/outputs for a Shuttle Car (10SC)

Inputs to the Joy Machine	Outputs from the Joy Machine
Fields Enabled	Park Brake Applied
Slow Down	Brake Pressure Detected
Stop	Pump Contactor De-Energised
2 nd Stop/Fault (Backup Trip signal)	Main Circuit Breaker Closed
	Power Supply to PDS

PDS on Development Equipment – Shuttle Cars

- When the park brakes are applied on the shuttle car, the PDS system is not active and personnel are allowed to enter the “Warning” or “Hazard” zones as the shuttle car cannot move
- The 3rd Party PDS system only becomes active when brakes are requested to be released by Shuttle Car operator
- The “Fields Enabled” signal must be received by the shuttle car from the PDS system to allow the shuttle car to tram (a “Handshake” type arrangement)

→ Operator actuates Brake Release Lever (brakes remain engaged via brake solenoid)

→ Signal Provided to PDS – via Mode Sense Valve or Brake Pressure Switch

→ PDS enables “fields” and provides confirmation input to the shuttle car

→ Brake Solenoid is released allowing machine to move.

PDS on Development Equipment – Shuttle Cars

Slow Down Function

- An output from the PDS system is received by the shuttle car when a person is detected in the “Warning Zone” (shown in yellow)
- The shuttle car reduces its speed to a percentage of its “current speed”
- This is achieved via relays switching resistor/s into the foot switch circuit
- The Operator Display will alarm “PROXIMITY ZONE WARNING”



PDS on Development Equipment – Shuttle Cars

Stop Function

- An output from PDS system is received by the shuttle car when a person is detected in the “Stop Zone” (shown in red)
- This is achieved by using hardwired relays to de-energize the Pump Contactor coil. This causes:
 - The Pump Contactor to open
 - The “Tram Enable” input into the VVVF Drives to be removed
 - The hydraulic pump to de-energize
 - Hydraulic pressure is removed from the Spring Applied, Hydraulic Released park brakes
 - The park brakes on the shuttle car to be applied, preventing any tramping movement of the shuttle car
- The Operator Display will alarm “PROXIMITY ZONE STOP”



PDS on Development Equipment – Shuttle Cars

Second Stop / Fault Operation (Back-up Trip) Function

- The shuttle car provides an output to the PDS system to confirm that the pump contactor has opened whenever the “STOP” function has been activated
- If the PDS system does not receive this output from the shuttle car after a “STOP” command has been issued, it will provide a “SECOND STOP/FAULT” output to the shuttle car
- When a “SECOND STOP/FAULT” output is received by the shuttle car, the main circuit breaker on the shuttle car will be tripped via its shunt trip mechanism, removing all power from the shuttle car and applying the park brakes





How a PDS system works on a Continuous Miner

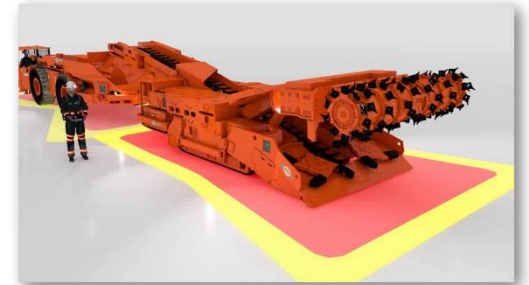
PDS on Development Equipment – Continuous Miners

- The hardwired interface provides the following inputs/outputs for a Joy Continuous Miner (12CM)

Inputs to the Joy Machine	Outputs from the Joy Machine
Warning	110Vac
Hazard	24Vdc
2 nd Stop	Mining Mode Active
	Bolting Mode Active
	Traction Speed
	Pump motor Energised
	Retrieval mode enabled

PDS on Development Equipment – Continuous Miners

- Komatsu have only fitted a 3rd Party PDS system to one Joy Continuous Miner in Australia
- The “Handshake” and “Second Stop/Fault” functions are applied to Continuous Miners as per the Shuttle Car arrangement discussed earlier
- The “Warning” and “Hazard” outputs from a 3rd Party PDS system can be used to activate any combination of the following:
 - Disable all hydraulic functions
 - Disable tramming functions
 - Disable the cutter motors
 - Disable the conveyor motors
 - Disable the conveyor tail swing left/right functions
 - Disable the conveyor tail raise/lower functions

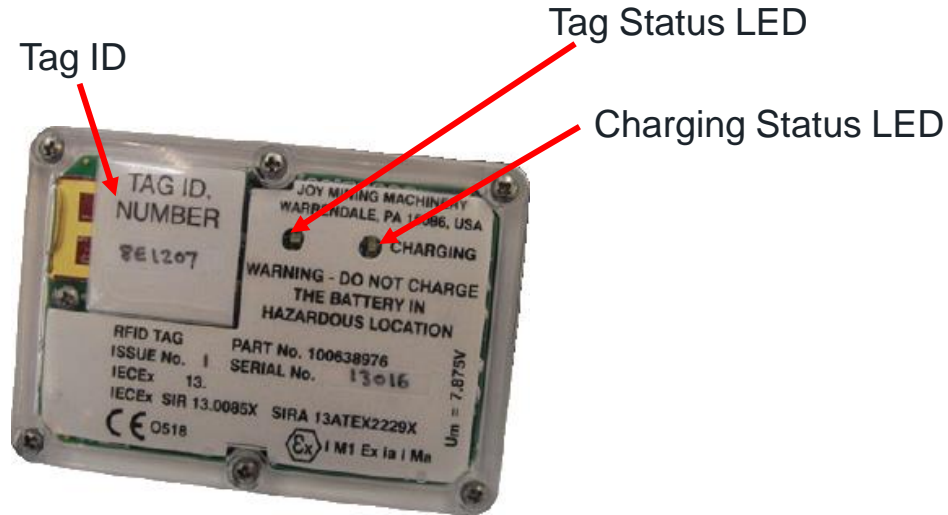




How a PDS system works on a PRS System

PDS on PRS Control Systems

- The Tag for the PRS Control system uses RF signal strength and an accelerometer to accurately locate the operators position in conjunction with each Mimic on the roof supports and along the MG/BSL/Matilda areas



PDS on PRS Control Systems

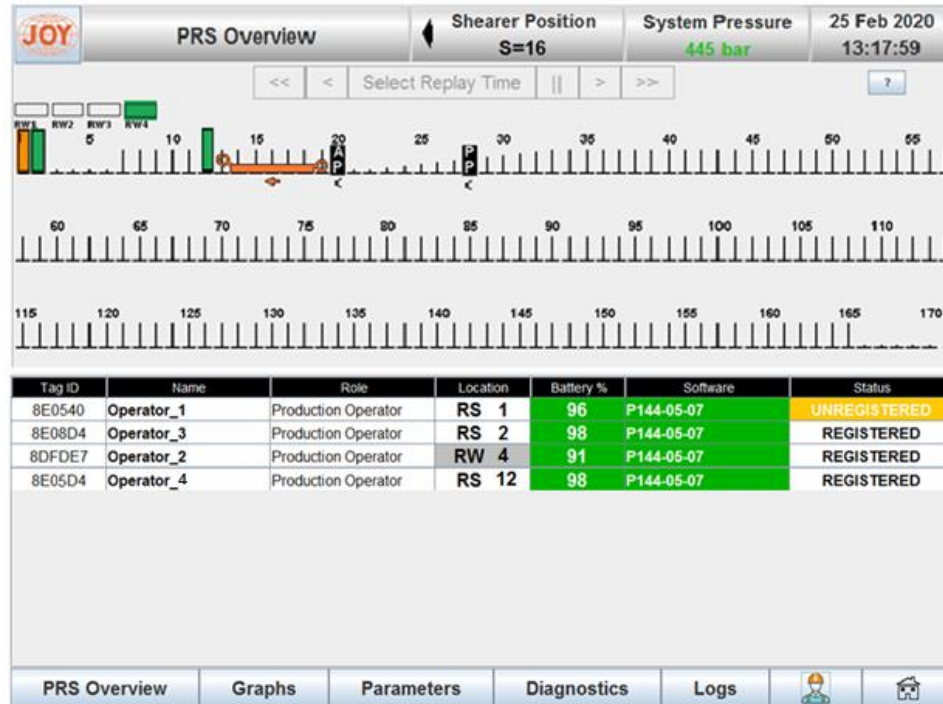
- A Tag is needed for all persons entering onto the Longwall. The signals from the Tag are detected by the RS20s Mimics giving the operators the reassurance that if they are detected within the halt headway of an initiated advancing shield, the shield will be halted at a safe distance away.



- Note: The PDS system does not protect the operator when using adjacent control, remote control or bank control functions

PDS on PRS Control Systems

- Any detection of a Tag and its movement across the Longwall will be visible from the MG CME LIS and surface PC's.



PDS on PRS Control Systems

- Tags must be registered when entering on to the LW for the following reasons:
 - To confirm the Tag is charged
 - To confirm the Tag is in full working order
 - To ensure that the PRS System has acknowledged and registered the Tag
 - To allow the PRS system to detect and react to unregistered tags i.e., unauthorised personnel on the face

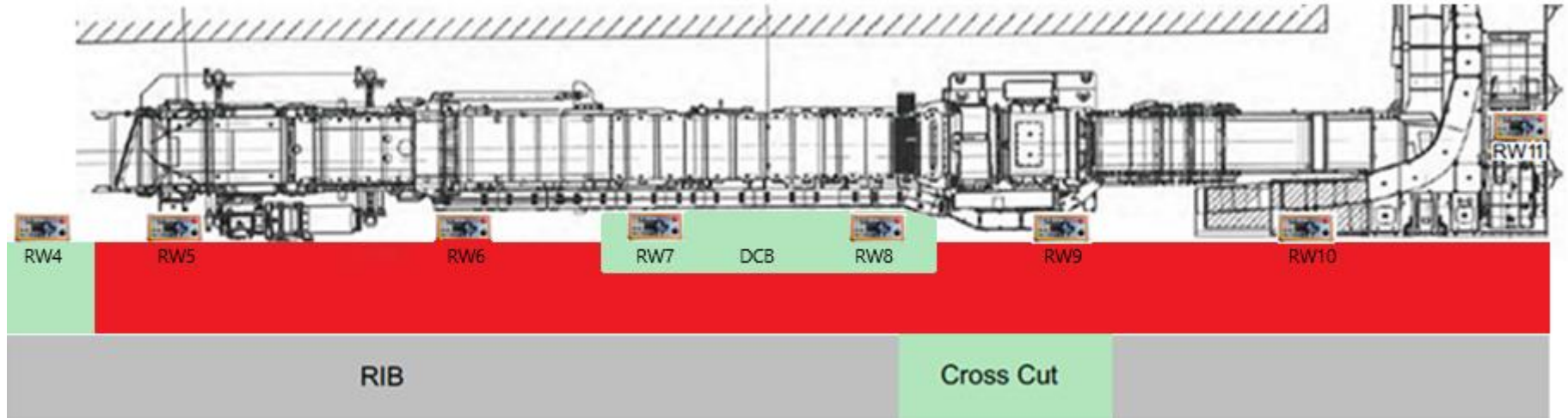


Note: if a person fails to register their tag, they will still be protected with the event log receiving a log of notification of the tag not being registered and a message will also follow the tag position on a mimic requiring the person to press OK to register

PDS on PRS Control Systems – BSL Push

The PDS system is active around the BSL area at the time when the BSL push will occur to prevent the BSL being pushed while personnel are in the NO GO ZONE.

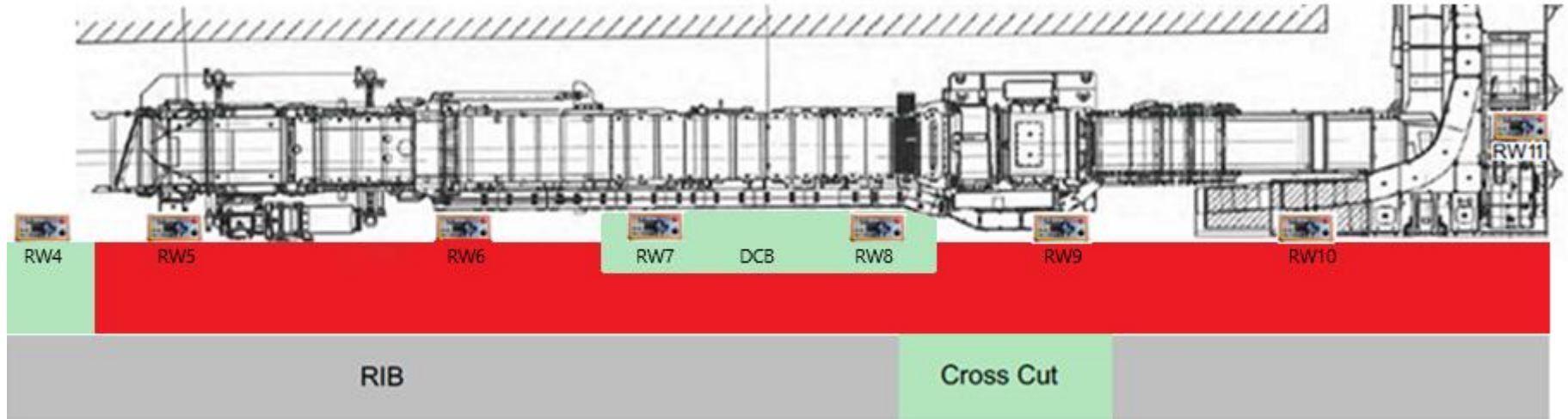
The only areas that personnel can stand during a push operation are on the DCB platform (around RW7 and 8), or at RW4 or further outbye (depending on installation configuration).



PDS on PRS Control Systems – BSL Push Release

The push release would be set up on RW8.

When pushing the BSL, operators should always check that the NO GO ZONE is clear and not be purely relying on the PDS system for protection.



PDS on PRS Control Systems

- The following mines in Australia have PPD installed on their PRS systems:
 - Mandalong
 - Appin A7
 - Appin A9
 - Dendrobium
 - Ulan West
 - Oaky North

PDS Limitations

- Functional Safety
 - The interface between the Joy machine and a 3rd party PDS system has been assessed as SIL Capable.
 - Komatsu is not the “system designer” and have not SIL rated the entire system
- Silent zones are required on both the Continuous Miner and Shuttle Car to avoid nuisance tripping of the system
- On Continuous Miners, only interactions at the rear of the machine are covered by PDS systems
 - Interactions with bolting rigs or movable platforms are not covered
- The PDS system (PPD) on the PRS control system may not react to a Tag location quickly enough if the wearer is walking the face too quickly and the headway parameter is set too low. Komatsu specify an accuracy of +/- 1 support in 10 seconds, so the distance travelled in 10 seconds needs a headway of X supports to prevent an operator from walking into a moving support zone i.e., the faster the walking speed, the greater the headway parameter setting.
- Without monitoring of zone interactions and taking remedial actions, such as educating coal mine workers where not to be, experience from the USA and South Africa has shown that behavior does not change around mobile machines. This leads to a reliance on the PDS system to protect personnel from hazardous events and therefore complacency regarding risky behavior

Future developments

- ISO 21815
 - Komatsu has no plans for the implementation of ISO 21815 on its underground coal mining equipment
 - ISO 21815 is primarily focused on Earth Moving Equipment used on the surface of mines in terms of the data transferred by the protocol and does not lend itself to Komatsu's underground coal mining machines
 - No customer has made a request to Komatsu for a PDS system to have an ISO 21815 interface so far
 - No 3rd party PDS supplier has made a request to Komatsu for an ISO 21815 interface on a Joy machine so far
- The PPD system (for PRS) is being developed to use Ultra wideband technology for faster response times. This will allow reduced headway distances/settings
- Komatsu will continue to work with its customers and 3rd party PDS system suppliers to provide practicable controls on Joy underground coal mining machines supplied by Komatsu



Any Questions?