

Goonyella Riverside Mine



BHP Billiton Mitsubishi Alliance

Dipper Trip System Improvement Project

Background

- *Shovels are an integral part of any open cut mining process*
- *Goonyella Riverside employs 3 shovels which are scheduled to operate 24 hours a day*

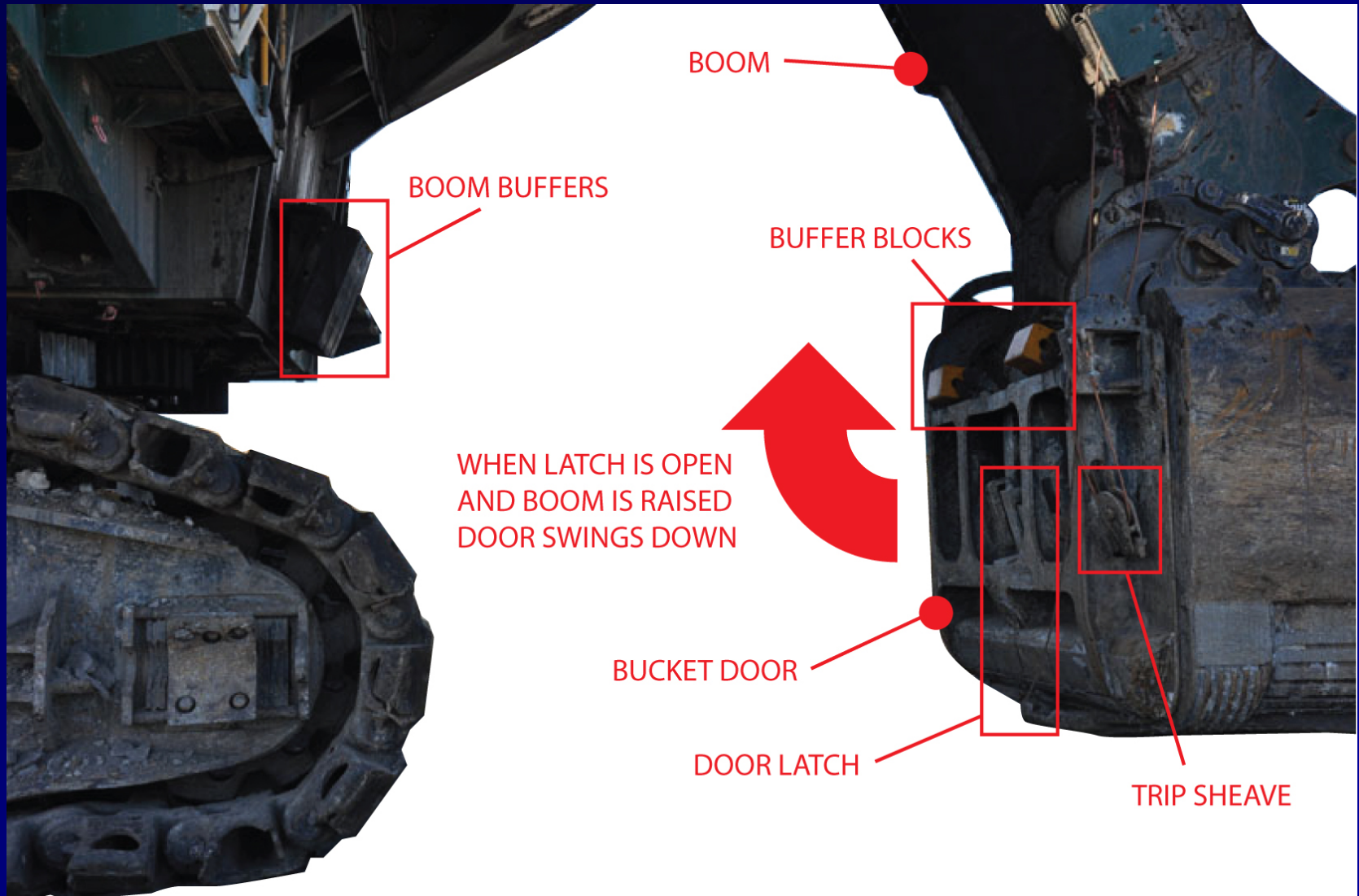


Background

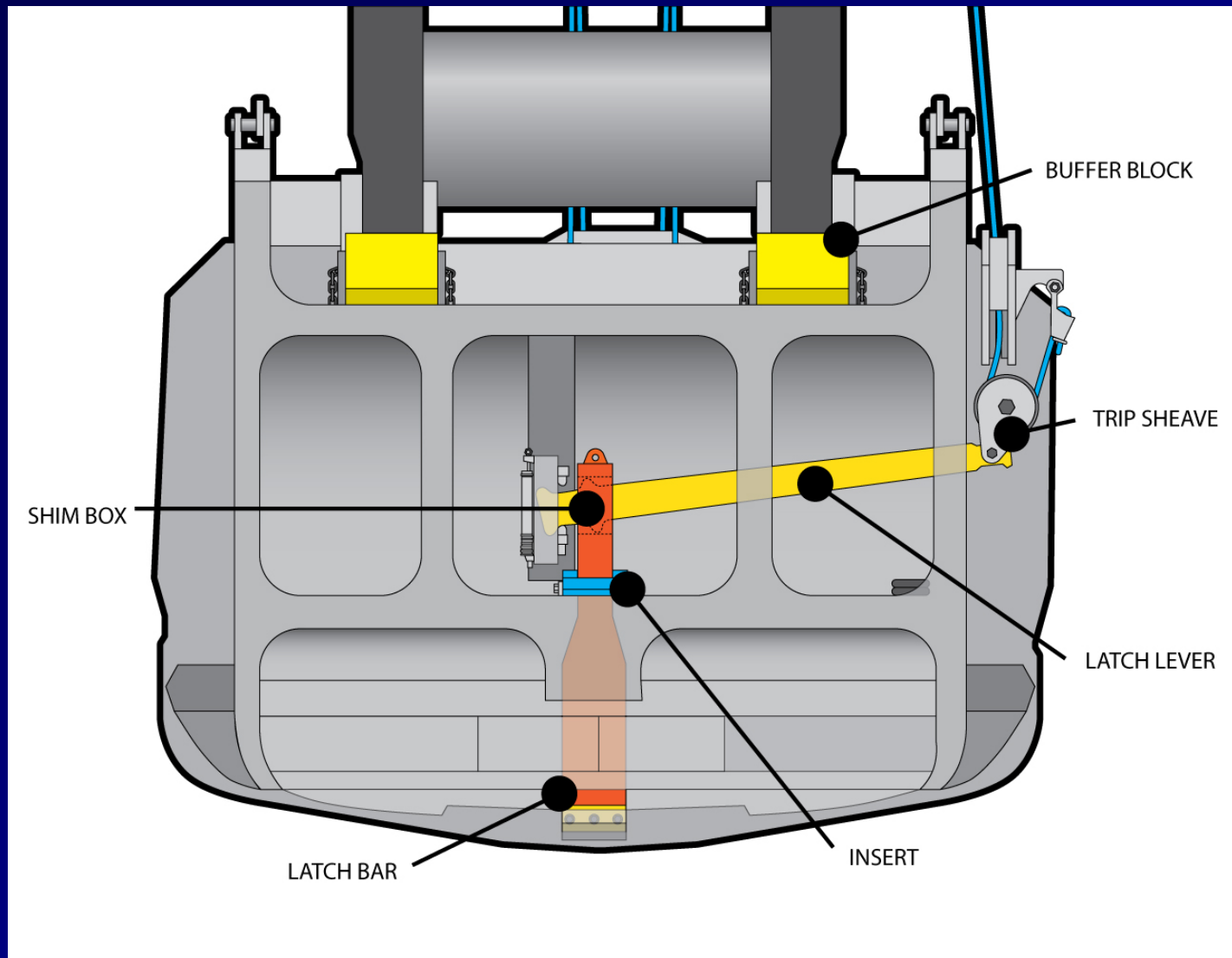
- *Shovels at Goonyella Riverside Mine are a part of the pre-strip process where rear dump trucks are loaded by the shovel with overburden which is then transported to overburden dumps located around the site*



Shovel Bucket Door Components

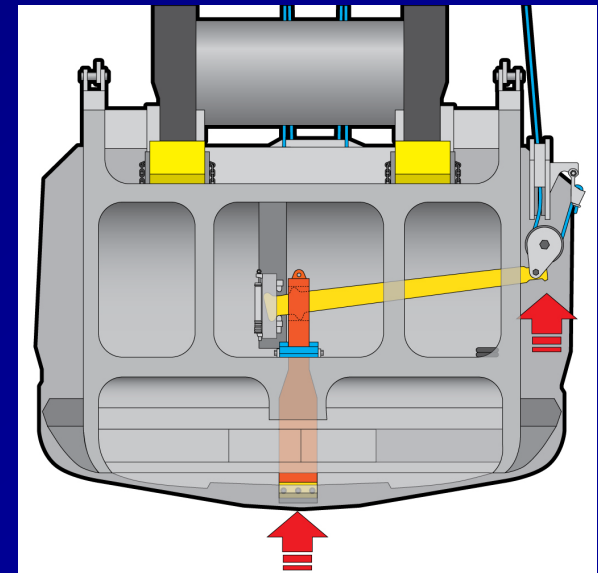
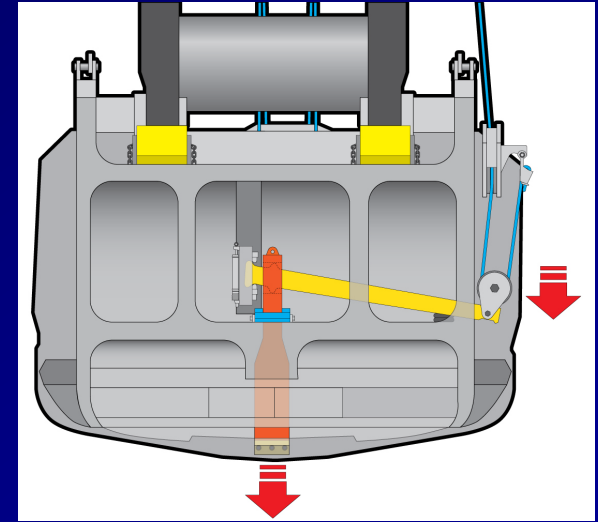


Shovel Bucket Door Components



The Problem - Overview

- *Shovels at Goonyella Riverside Mine were regularly experiencing production delays due to the dipper trip mechanism jamming and failing to release the dirt load.*
- *Once this mechanism failed, the shovels were rendered inoperable*
- *To repair the problem, the shovel was required to be shut down causing this shovels pre-strip fleet to be placed on stand by.*



The Problem - Production

- *Over 1 year, with 3 shovels in operation 24 hours a day, 2 shifts a day, at least 548 hours of lost production was experienced per year.*
- *During the 548 hours, the pre-strip truck fleet was delayed while waiting for the shovel to be repaired.*

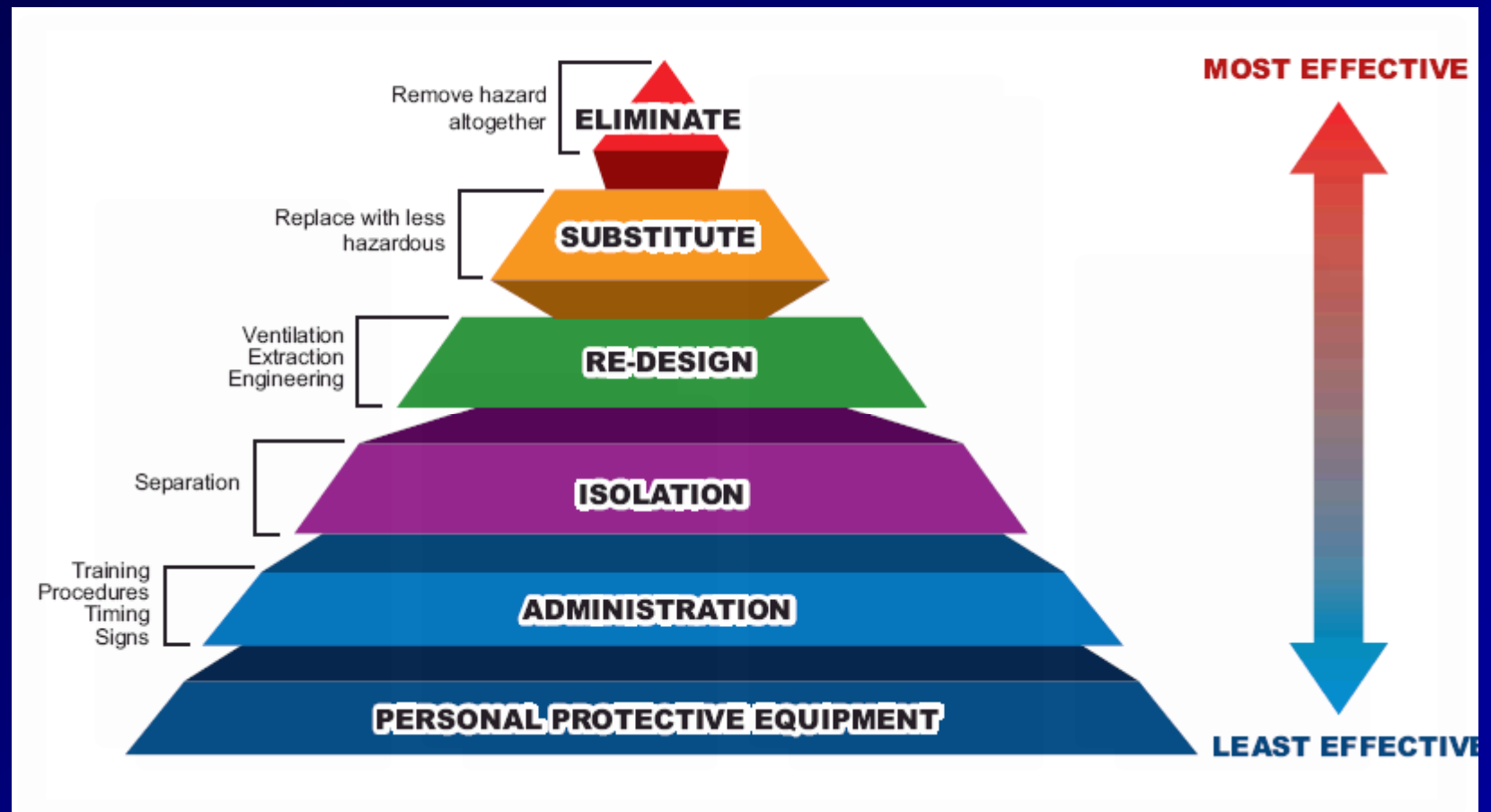


The Problem - Safety

- *Statistically in the Mine Maintenance Department at Goonyella Riverside, the things that hurt our people are:*
 - *Strains and sprains*
 - *Line of fire injuries associated with hands*



The Problem - Overview



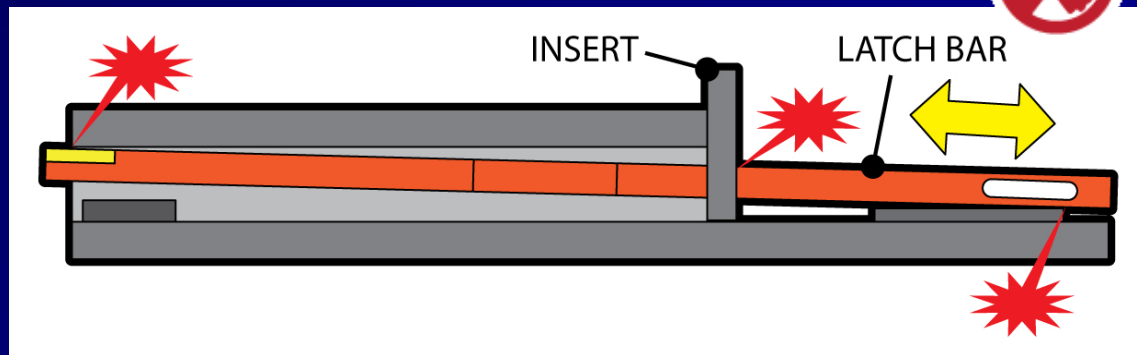
*The solution to the **safety**,
environmental and **production**
problems resulting from this trip mechanism
were solved by addressing the re-alignment
of the latch tube and focussing on the
safety issues*

The Solution – Dipper Trip System

Re-aligning Latch Lever Path

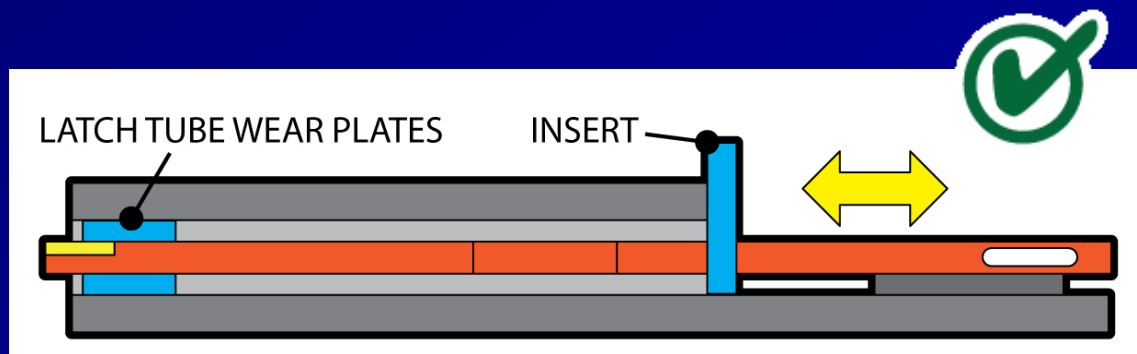
Problem

Latch lever path was out of alignment causing steel on steel drag, friction and wear.



Solution

Re-aligned slots and placed polyurethane wear strips to prevent steel on steel friction and wear.



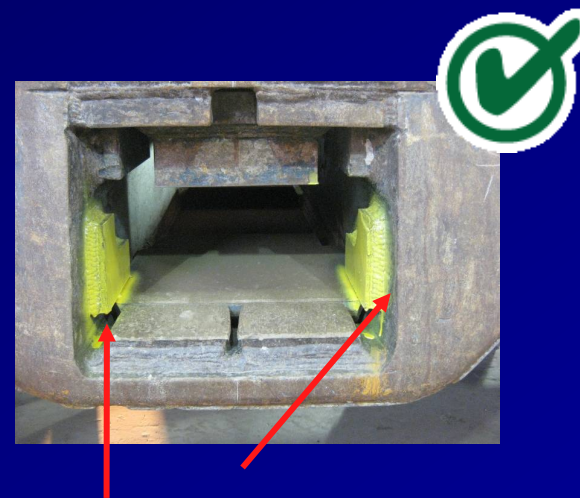
The Solution – Dipper Trip System

Securing Bottom Latch Tube Wear Plate



Problem

This photo demonstrates how the Maintenance Crew held the bottom latch tube wear plate in place while lowering the latch bar into the tube. This plate also dislodged and became a wedge jamming the latch bar.



Solution

The bottom latch tube wear plate is being held in place by the modified latch bar guide plates which prevents the bottom latch tube wear plate from falling out during operation and maintenance.

The Solution – Dipper Trip System

Re-aligning Shim Box



Problem

This photo depicts the 35mm mis-alignment from the centre of the shim box to the centre of the latch bar creating wear and friction



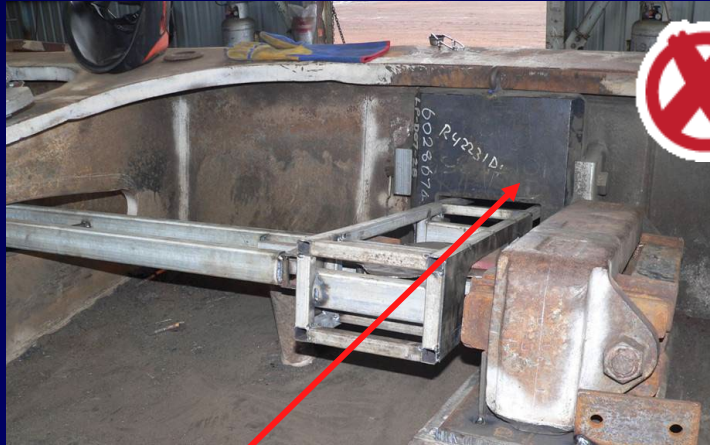
Solution

Jig was developed to re-align shim box with latch bar and lever.

The shim box, has been shimmed up 35mm and re-welded in the same alignment as the latch bar.

The Solution – Key Safety Solutions

Nylon Lubricated Upper Insert



Problem

Upper insert was constructed of steel and weighed **45kg**.

Hard to extract prior to removing latch bar
Potential for strain/sprain and line of fire injuries.

While in operation, this steel insert created steel on steel friction which caused the latch bar to jamb and wear.



Solution

A lubricated nylon upper insert was developed which only weighs **4kg**. It is easy to remove, reduced the potential for strain/sprain and line of fire injuries, creates minimal friction at all and eliminates jamming and wear.

The Solution – Dipper Trip System



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Re-aligning Trip Sheaves



Problem

Upper and lower trip sheave were misaligned and too close together, resulting in twisting of the latch lever and causing sheaves to double block.



Solution

Upper trip sheave relocated and the anchor point moved to correct alignment and prevent double blocking.

The Solution – Key Safety Solutions

Dipper Door Buffer Blocks



Problem - Retainment

Old buffers were made of rubber and retained by a 50mm pin. When these buffers became damaged, the steel lugs would hit the shovel boom, squashing the lugs and jamming the pin in place, making the buffers impossible to remove. These buffer blocks only lasted approximately **6 weeks**.



Problem - Removal

Flame cutting the pin inside the rubber buffer is the only way to remove the damaged pins. This area is surrounded by combustible lubricants and grease lines, creating fire hazards and potential burn injuries.

The Solution – Key Safety Solutions

Dipper Door Buffer Blocks



Solution - Retainment

Polyurethane buffers developed for better impact qualities. Retaining lugs were cut and modified. A chain and hammer locks are now used to retain the buffer in place. These buffers last approximately **20 weeks**.



Solution - Removal

To remove buffers after using the chain and hammer lock modification, the hammer lock can either be removed by flame cutting with the oxy with very minimal fire hazards or tap the pin out with a hammer and punch which eliminates all fire hazards.

The Solution – Key Safety Solutions

Replacement of Boom Buffers



Problem

Old buffers were approximately 80kgs each. Buffers were required to be lifted manually into place – approximately 7 meters up on the shovel boom.



Before Solution

Rubber buffers in place before solution. This took 4 - 5 maintenance personnel to manually put the buffers in place. The job generally took 5 – 6 hours.

The Solution – Key Safety Solutions

Replacement of Boom Buffers



Solution

These buffers are slightly heavier but include a mechanical lifting lug moulded into the frame. This allows the buffer to be lifted by a crane and put in place. Eliminates manual handling.



After Solution

By using a crane, this task now takes 3 people approximately one hour. This solution eliminates the manual handling and line of fire hazards.

The Solution – Key Safety Solutions

Latch Bar Maintenance Stand



Problem

Welding the latch bar to the bench while holding it in position with a crane required employees to squat in an awkward position to perform the task. This created ergonomic issues for the welder.



Solution

By using the trestles and the latch bar maintenance stand, the task was made safer as the bar was held in a more secure way.

Ergonomic issues were also eliminated.

The Solution – Key Safety Solutions

Dipper Door Maintenance Pod

The design and fabrication of a Dipper Mechanism Maintenance Pod to contain all of the components associated with maintaining the system.

This reduced much of the manual handling risk presented by handling these components individually.

By only requiring one strap to secure the pod to the back of the truck, it has eliminated load restraint problems.



Benefits and Effects - Overview

		CONSEQUENCE SEVERITY				
PROBABILITY FACTOR		Level 1	Level 2	Level 3	Level 4	Level 5
A	Happens often	High	High	Extreme	Extreme	Extreme
B	Could easily happen	Moderate	High	High	Extreme	Extreme
C	Could happen and has occurred here or elsewhere	Low	Moderate	High	Extreme	Extreme
D	Hasn't happened yet but could	Low	Low	Moderate	High	Extreme
E	Conceivable, but only in extreme circumstances	Low	Low	Moderate	High	High
TOLERABLE			ALARP	ALARP	INTOLERABLE	

The innovation has met and exceeded our initial expectations and has reduced a previously high risk task of repairing and maintaining the dipper trip system and associated components to a low risk activity.

Benefits and Effects - Safety



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- *While working on a solution for the Dipper Trip System, many safety hazards were identified and their elimination was included in the overall project.*
- *This project has significantly reduced and in some cases eliminated the substantial manual handling and materials risks.*
- *Maintenance employees have been removed from:*
 - *Trip hazards*
 - *Strains and sprains*
 - *Manual handling hazards*
 - *Line of fire hazards*

Benefits and Effects - Safety

- *Dipper door trip failures would often result in the dipper contacting the trucks and its load causing the trucks to jolt.*
- *This created a hazard and had the potential to cause minor injury to the truck operator.*



Benefits and Effects - Environmental

- *Reduced shovel down time equates to less wasted fuel emissions from associated pre-strip trucks and dozers.*
- *Replacement of the old rubber buffers with polyurethane buffers to the 3 shovels at Goonyella Riverside Mine increased the life of the buffers which saves approximately **5 Tonnes** of rubber per year.*



Benefits and Effects - Production

- *The changes have also improved system reliability whilst reducing component change out times.*
- *The project has also reduced the cost of consumables necessary to maintain the system on an ongoing basis.*
- *Change out time has been reduced from 5 – 8 hours down to 1.5 – 3 hours.*
- *Less equipment damage by eliminating dipper truck contact.*



Transferability Across the Industry

- *All of these enhancements can be directly applied to other P&H 4100 series electric shovels and their associated maintenance practices across the mining industry.*
- *Many of the enhancements can also be applied to other P&H shovels series that are fitted with similar dipper trip mechanisms.*
- *Goonyella Riverside Mine has also provided the designs to other BMA sites as well as P&H as the manufacturer.*



- *The project has demonstrated an extremely high level of resourcefulness and innovation.*
- *The original style of dipper trip system has been in service for over 15 years.*
- *From an idea to improve maintenance and production of our shovels, came a significant amount of safety improvements.*

Questions?

