Reducing the Risk of Uncontrolled Vehicle Movements in Light Vehicles

"MEETING THE NEEDS OF THE CUSTOMER"

A CASE STUDY

MINEvolution 2011
Mine Machine Productivity and Safety
Burswood - 23rd and 24th May 2011

Ken Johnsen
CEO – Advanced Braking Technology Ltd

KEY MESSAGE

- After extensive consultation with its customers ABT developed an upgraded version of its already well proven SIBS braking system
- Main Aim - to further enhance safety benefits and improve serviceability, operating cost and vehicle up time
- End Goal – reducing uncontrolled vehicle movements

BACKGROUND ON COMPANY

- ASX Listed Company formed to develop and manufacture the patented SIBS braking system
- Core technology – the single rotor enclosed wet brake
- Manufactured in Thailand by wholly owned subsidiary
- Sold worldwide with focus to date on mining products
- New products under development for on-road application (garbage trucks)

ABT
Advanced Braking Technology Ltd

Major Customers

RIO TINTO

bhpbilliton

BARRICK

ANGLO AMERICAN

xstrata

Companhia Vale do Rio Doce

Barminco
Underground mining professionals

MPI MOBILE PARTS INC
Mining & Equipment Parts

DownerEDi Mining

BYRNECUT MINING

MACMAHON

LEIGHTON

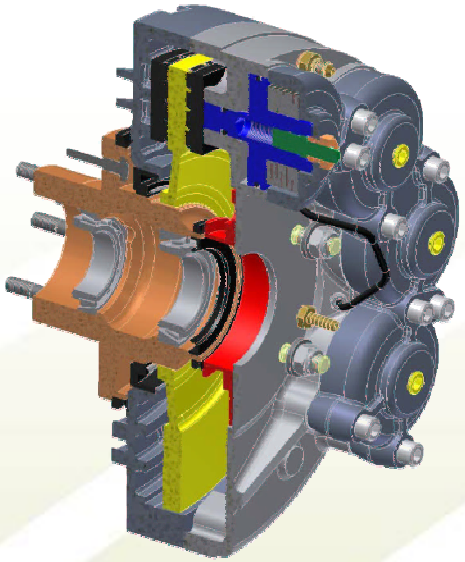
BUCYRUS

Advanced Braking Technology Ltd

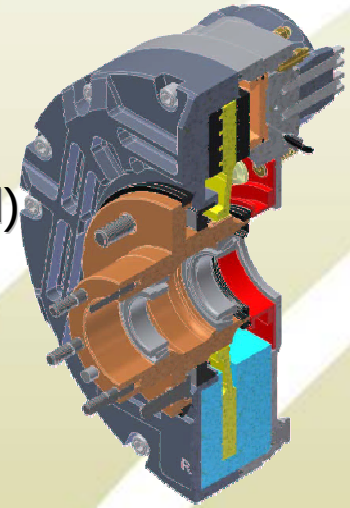
ABT's Mining Product Applications

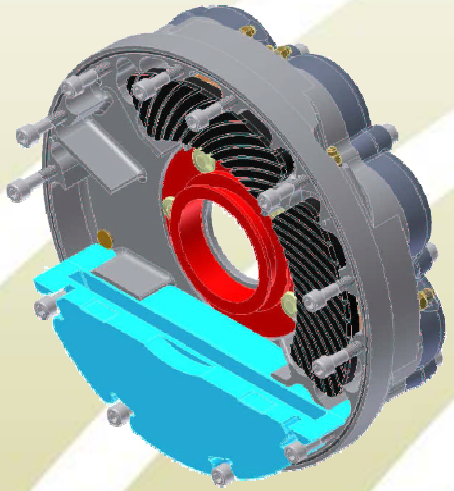
The SIBS Brake System

- **Sealed Integrated Brake System (SIBS):**
  - Brake rotor and pads enclosed in a sealed housing.
  - Braking elements operate in a fluid that dissipates the heat generated by braking.
  - Very low wear rates due reduced heat at braking interface.
  - Floating rotor delivers balanced brake pad force and uniform pad wear.
  - Proven reliability over a decade in harsh mining conditions.



- **Four brake functions:**
  - Automatic fail-safe brake (spring applied)
  - Operator applied emergency brake
  - Reliable park brake (push button)
  - Reliable service brake





Value Proposition

SIBS offers:

- Fail to safe functionality
- Reduced vehicle maintenance costs
- Reduced vehicle downtime
- Reduced brake temperature
- More reliable and consistent braking
- Elimination of airborne particle emissions

SAFETY and RELIABILITY

Case Study
Xstrata Zinc George Fisher Mine

- Increased focussed on uncontrolled vehicle movements of all underground vehicles precipitated a review of the overall effectiveness of SIBS in meeting the ever increasing requirements of harsh underground conditions for light vehicles
- ABT worked with Xstrata to determine a “wish list” of desired product improvements.
- Based on the wish list ABT commenced a development program to upgrade the existing product to incorporate the desired improvements

Development Project

- July 2010 - A development team put in place to carry out to upgrade the existing SIBS brake design for Landcruisers
- Project was named SIBS II
- July to September 2010 – enhancements developed from wish list and prototype unit developed and tested.
- September to October 2010 – manufacturing tooling and supplier changes implemented in preparedness for supply
- July to October 2010 – continuous consultation with Xstrata Zinc staff to ensure upgraded product meets desired outcomes.
- 15th October 2010 – Xstrata Zinc Mount Isa Mines commits to a whole of site roll out on Landcruisers with an order of 96 sets
- 31st December 2010 – delivery of 96 sets completed
- Jan to May 2011 – Xstrata staff install brake sets on vehicles

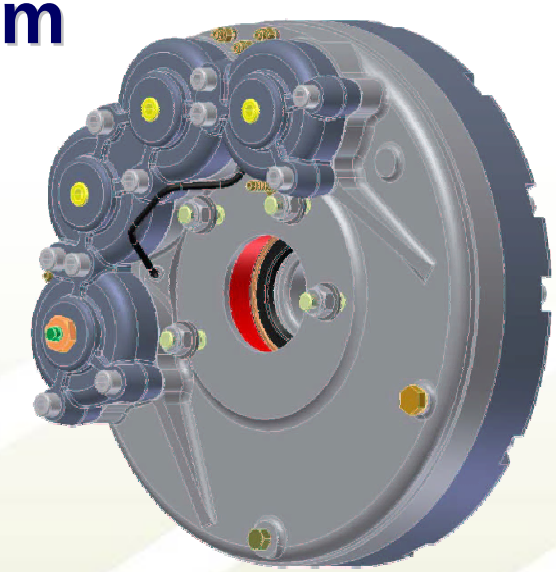
Wish List
(Key Items)

- The operator should know when the brake is on and when it is off
- An external pad wear indicator is required
- Key components should have greater corrosion resistance
- Aspects of installation and servicing need improvement

The End Result
SIBS II – New Standard Features

- Modular brake system (Service exchange)
- Rear brake module:
  - Inner housing studs (Allows modular removal)
  - Upgraded wheel bearing seal arrangement
  - External brake pad wear indicator
  - Increased diameter SIBS fill and level plug
  - Stainless steel hex head housing bolts
- Emergency Brake pump module:
  - Marine grade EMMA pump standard
  - Stainless steel reservoir
- Control box module:
  - New warning light scheme with audible alarm
- Emergency Brake hose upgrade

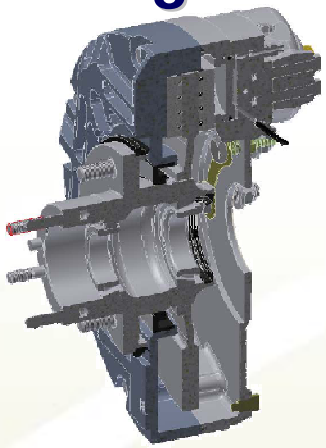
Modular Brake System



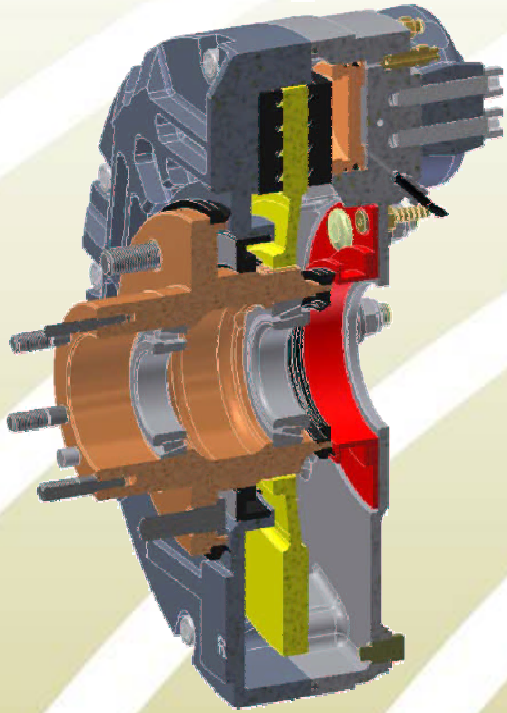
- **Major system modules:**
  - Rear brake module (including hub)
  - Emergency brake pump module
  - Control module
  - Plumbing kit
  - Wiring harness
- **Changes to the rear brake module:**
  - Inner housing studs allows the rear brake module to be removed as a single complete module including the hub.
- **Advantages:**
  - All system modules can be removed and exchanged for new or serviced components:
    - Minimises vehicle downtime
    - Simplifies servicing
    - System modules can be serviced/repaired offline.

Rear Brake Module: Upgraded wheel bearing seal arrangement

- **Description:**
  - V-lip seal introduced to keep SIBS fluid separated from the wheel bearing seal.



- **Changes:**
  - Secondary seal and seal carrier added.



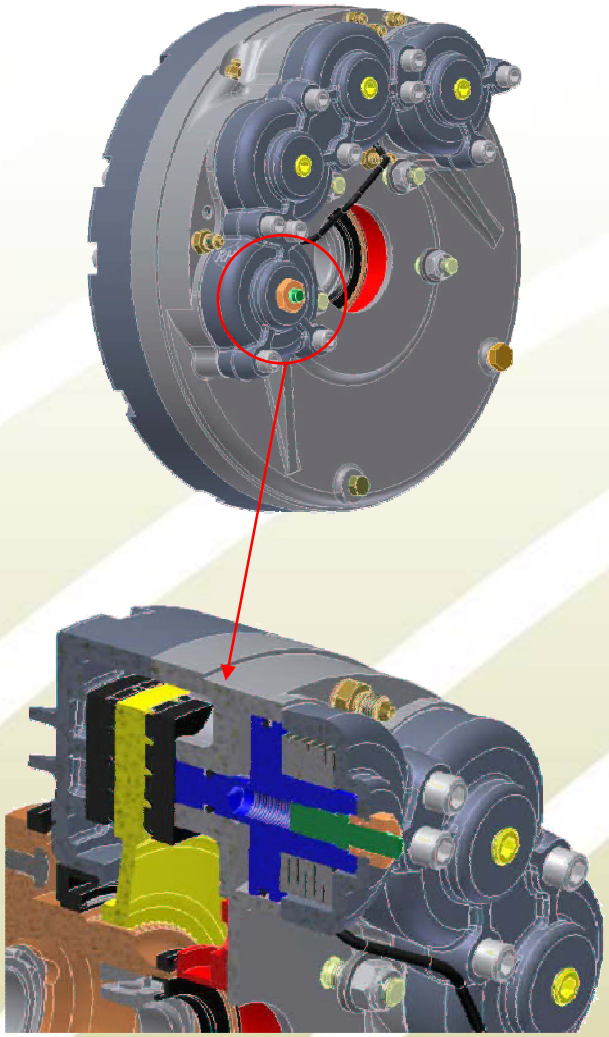
- **Advantages:**
  - New seal keeps SIBS fluid away from wheel bearing seal (designed to keep bearing grease in)
  - Minimises potential for wheel bearing grease to be washed out by SIBS fluid.

Rear Brake Module: External brake pad wear indicator

- **Description:**
  - Stainless steel brake pad wear indicator protrudes from the inner housing.

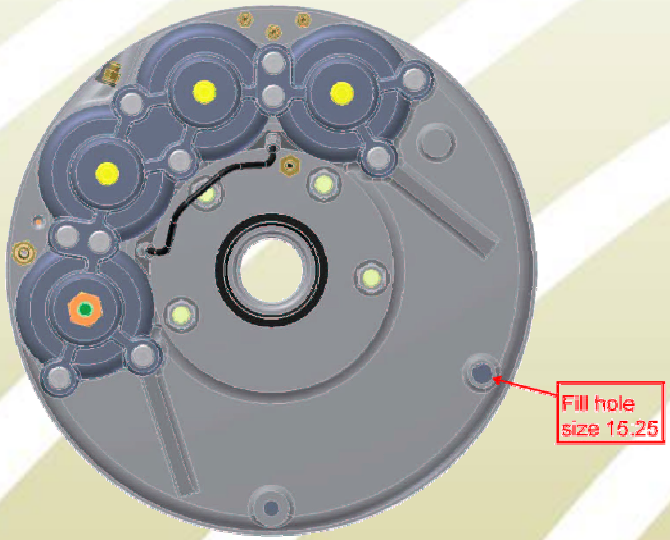
- **Changes:**
  - A brake pad wear indicator pin is added to rear of the Emergency Brake piston with protective stainless cap.
  - The brake pad wear indicator protrudes through the spring cover to show the spring pack compression – this measurement determines if the brake pads require replacement.

- **Advantages:**
  - Easy to check the brake pad wear during normal servicing without the need to disassemble the brake.



Rear Brake Module: Increased diameter SIBS fill & level plug

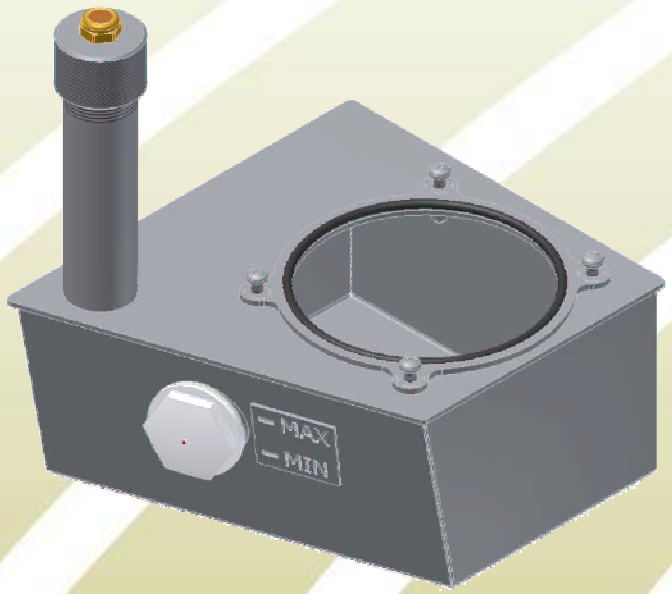
- **Description:**
  - Larger SIBS filler hole - to allow use of standard and automated fill tubes.
  - The fill hole is repositioned at the correct SIBS fluid level.
- **Changes:**
  - Modified fill hole size and hole position in the inner brake housing.
- **Advantages:**
  - Compatibility with automated fill systems enabling faster and cleaner filling.
  - SIBS fluid can be filled to plug level preventing overfill.



Emergency Brake Module: Stainless steel reservoir

- **Description:**
  - Stainless steel reservoir with level indicator and dipstick replaces the current plastic and aluminium reservoirs.

- **Advantages:**
  - Improved robustness of the Emergency Brake reservoir (strength and heat resistance).
  - Easier reservoir filling.
  - Visible fluid level indication.



Control Module: New warning light scheme

- **Description:**
  - New light indication scheme:
    - Static Green – Emergency Brake is fully **released**
    - Flashing Red and audible alert – Emergency Brake is in **transition** (being applied or being released)
    - Static Red – Emergency Brake is fully **applied**

- **Changes:**
  - A second pressure switch has been added to the Emergency Brake pump assembly to positively indicate that the Emergency Brake pressure is in an intermediate state. The status lights and audible warning are actively operated by the Emergency Brake system pressure rather than the switch contacts.

- **Advantages:**
  - The flashing red light and audible warning alerts the driver that the Emergency Brake is either being released or more importantly that the brake is being applied.

Control Module: New warning light scheme

Solid Red Light

Emergency brake fully applied

Flashing Red Light with Audible Alert

Emergency brake partially applied

Solid Green Light

Emergency brake fully released

Emergency Brake Hose Upgrade

- **Description:**
  - Stainless steel tubes replace flexible Emergency Brake hoses across the rear axle.
  - 2 piece heavy duty flexible Emergency Brake hose between the Emergency Brake pump and the rear axle.
  - All flexible hoses fitted with Spiral Guard to protect against abrasion.

Hose comparison:
Single braid: SAE100R1-AT (11,000psi /758bar burst pressure)
Double braid: SAE100R2-AT (23,200psi/1,600bar burst pressure)

- **Advantages:**
  - Improved robustness of all Emergency Brake pipe work.
  - Easy replacement of rear Emergency Brake hose section between the chassis and the rear axle to minimise service time.

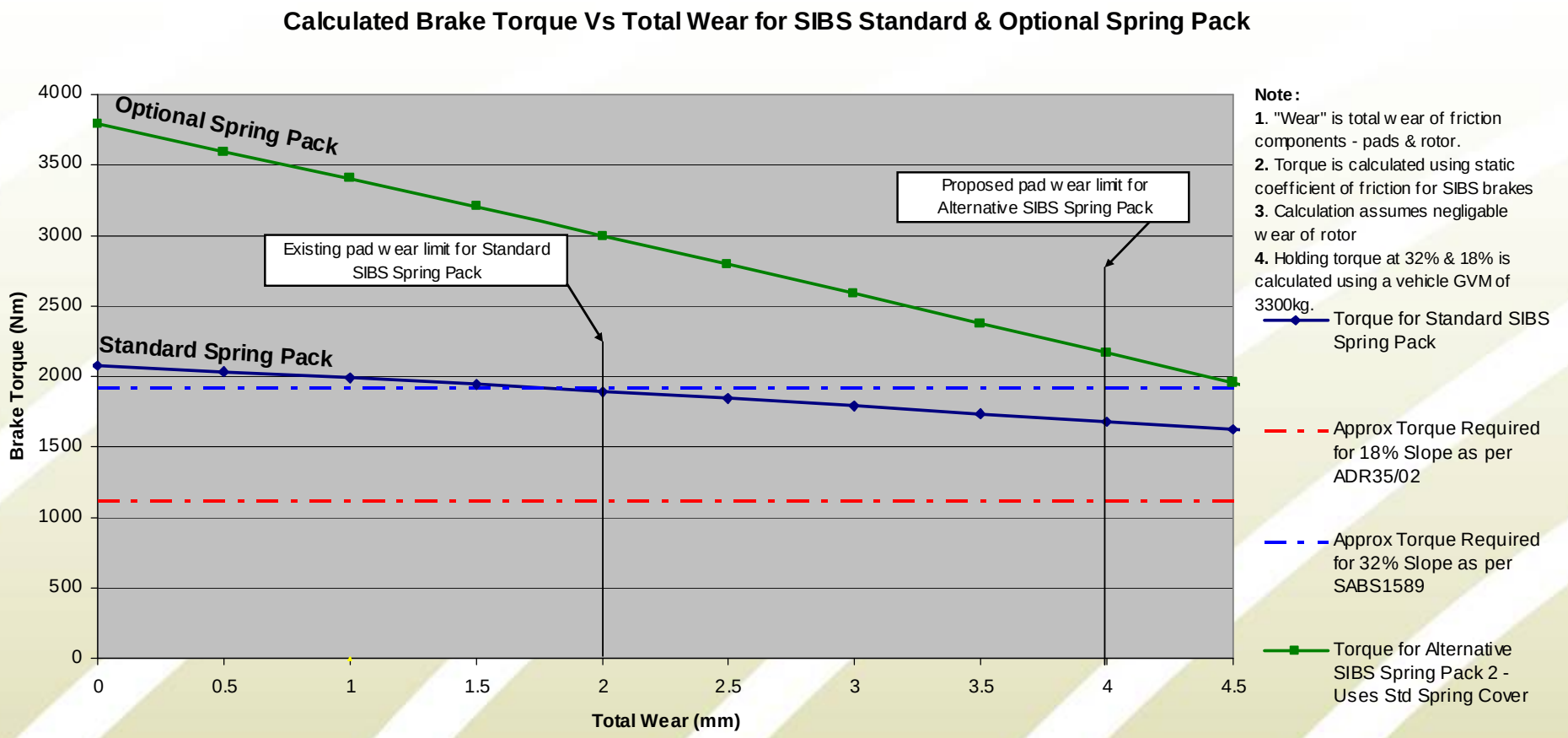
Option: Increased Emergency Brake torque

- **Description:**
  - Heavy duty Bellville spring packs are installed in the Emergency Brake.
  - Increases the torque applied by the Emergency Brake to prevent accidental brake “drive-over” (operating the vehicle with the Emergency Brake still applied).
  - Increased brake pad wear is able to be tolerated by the Emergency Brake.

  Note: The Emergency Brake application rate is faster and more aggressive with this option.

- **Features:**
  - Reduces incidences of premature brake pad wear and brake overheating damage due to brake drive-over.
  - Heavy duty spring pack increases allowable brake pad wear thus reducing spare parts requirements.

Option: Increased Emergency Brake option



Site Requirement at George Fisher

xstrata
zinc

Date: 17/05/2011

To whom it may concern

Xstrata Zinc George Fisher Mine is continually focussed on achieving an injury free, safe work environment for all employees and contractors, In this continuous effort to improve safety all light vehicles used in the underground environment at George Fisher Mine MUST be fitted with the following safety system which will be enforced from 01/09/2011 -:

"Advanced Braking Technology's (ABT)– Light Vehicle SIBS II, Fail Safe Wheel End Wet Braking System" (or similar).

Light Vehicles used for surface operations only will NOT need to have this system fitted.

To ensure this change causes no delay to the operation, it will be necessary for all vehicles to have this system fitted in time to allow a George Fisher mine vehicle inspection and compliance assessment to be completed prior to the 01/09/2011. The required assessments can be arranged by contacting the Light Vehicle Workshop at George Fisher Mine on #4744 6313.

After the 01/09/2011, any light vehicle not fitted with the above fail safe braking system will be denied underground access to George Fisher Mine.

All other non fit for purpose vehicles (on highway use) travelling underground at George Fisher Mine will be required to have a similar fail safe system fitted in line with the manufacturers recommendations by 01/01/2012 and will be assessed as above.

Regards

Robert Walker
Act Mine Manager
Xstrata George Fisher Mine

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17th May 2011

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"Advanced Braking Technology's (ABT) – Light Vehicle SIBS II Fail Safe Wheel End Wet Braking System" (or similar)

Standard Brake – Maintenance Requirements

- Typical maintenance requirements for standard rear brakes on a Toyota Landcruiser used in mining conditions include:
  - Weekly adjustment of the handbrake
  - Monthly replacement of the rear brake pads
  - 2 monthly replacement of rear brake rotors and callipers
  - 6 monthly replacement of the handbrake cable
  - 12 monthly replacement of the handbrake lever mechanism

SIBS II Maintenance Schedule

- **Every 250hrs/Monthly**

  Check:

  Brake housings for leaks
  Brake pad wear indicator (within limits)
  Emergency Brake hoses and brake hoses for leaks and general condition.
  Emergency Brake pump for leaks
  Wiring harness

  Maintenance:

  Drain and replace Emergency Brake fluid
  Grease wheel bearings
  Grease V-Seal
  Perform system operation and performance test

- **Every 2000 hrs/Annual**

  Maintenance:

  Exchange brake housings (service exchange – general inspection and replace seals as necessary)
  Perform 250 hour checks
  Perform system operation and performance test

➢ Note: Actual maintenance requirements are dependent on operating environment.

Cost Of Ownership Analysis*

LANDCRUISER WITH STANDARD REAR BRAKES

Initial Purchase and Installation			Parts Cost			Installation Cost	Total Cost	Comments
Brake purchase and installation			$ -			$ -	$ -	
Service Item	**Service Interval (weeks)**	**Service Parts Cost**	**Annual Spare Part Cost**	**Labour hours (per event)**	**Labour cost (per service)**	**Annual Labour Cost**	**Total Annual Cost**	**Comments**
Adjust handbrake	1	$ -	$ -	0.25	$ 24	$ 1,235	**$ 1,235**	
Replace rear service brake pads	4	$ 86	$ 1,118	0.50	$ 48	$ 618	**$ 1,736**	
Replace rear rotors	9	$ 250	$ 1,444	1.50	$ 143	$ 823	**$ 2,268**	Incremental time over changing service brake pads
Replace rear calipers	9	$ 618	$ 3,571	0.50	$ 48	$ 274	**$ 3,845**	Incremental time over changing brake rotors
Replace hand brake pads	13	$ 193	$ 771	0.50	$ 48	$ 190	**$ 961**	Incremental time over changing rotor and caliper
Replace hand brake lever mechanism	52	$ 125	$ 125	0.50	$ 48	$ 48	**$ 172**	
Replace hand brake cable	26	$ 125	$ 249	0.50	$ 48	$ 95	**$ 344**	
TOTAL ANNUAL COST			**$ 7,278**			**$ 3,283**	**$ 10,560**	

LANDCRUISER WITH REAR SIBS BRAKES

Initial Purchase and Installation			Parts Cost			Installation Cost	Total Cost	Comments
Brake purchase and installation			$ 8,750			$ 1,900	**$ 10,650**	The removed standard brake parts have significant value
Service Item	**Service Interval (weeks)**	**Service Parts Cost**	**Annual Spare Part Cost**	**Labour hours (per event)**	**Labour cost (per service)**	**Annual Labour Cost**	**Total Annual cost**	**Comments**
Change SIBS fluid	4	$ 27	$ 356	1.00	$ 95	$ 1,235	**$ 1,591**	
Replace EMMA filter	52	$ 124	$ 124	6.00	$ 570	$ 570	**$ 694**	Labour for service exchange (2 hrs) & brake overhaul (4 hrs)
Replace EMMA fluid (ATF)	52	$ 25	$ 25				**$ 25**	
Replace hydraulic hose (bulkhead to rear axle)	52	$ 56	$ 56				**$ 56**	
Replace service piston seals	52	$ 60	$ 60				**$ 60**	
Replace emergency brake seals	52	$ 260	$ 260				**$ 260**	
Replace hub seals	52	$ 308	$ 308				**$ 308**	
Replace brake pads	104	$ 225	$ 113				**$ 113**	
TOTAL ANNUAL COST			**$ 1,301**			**$ 1,805**	**$ 3,106**	

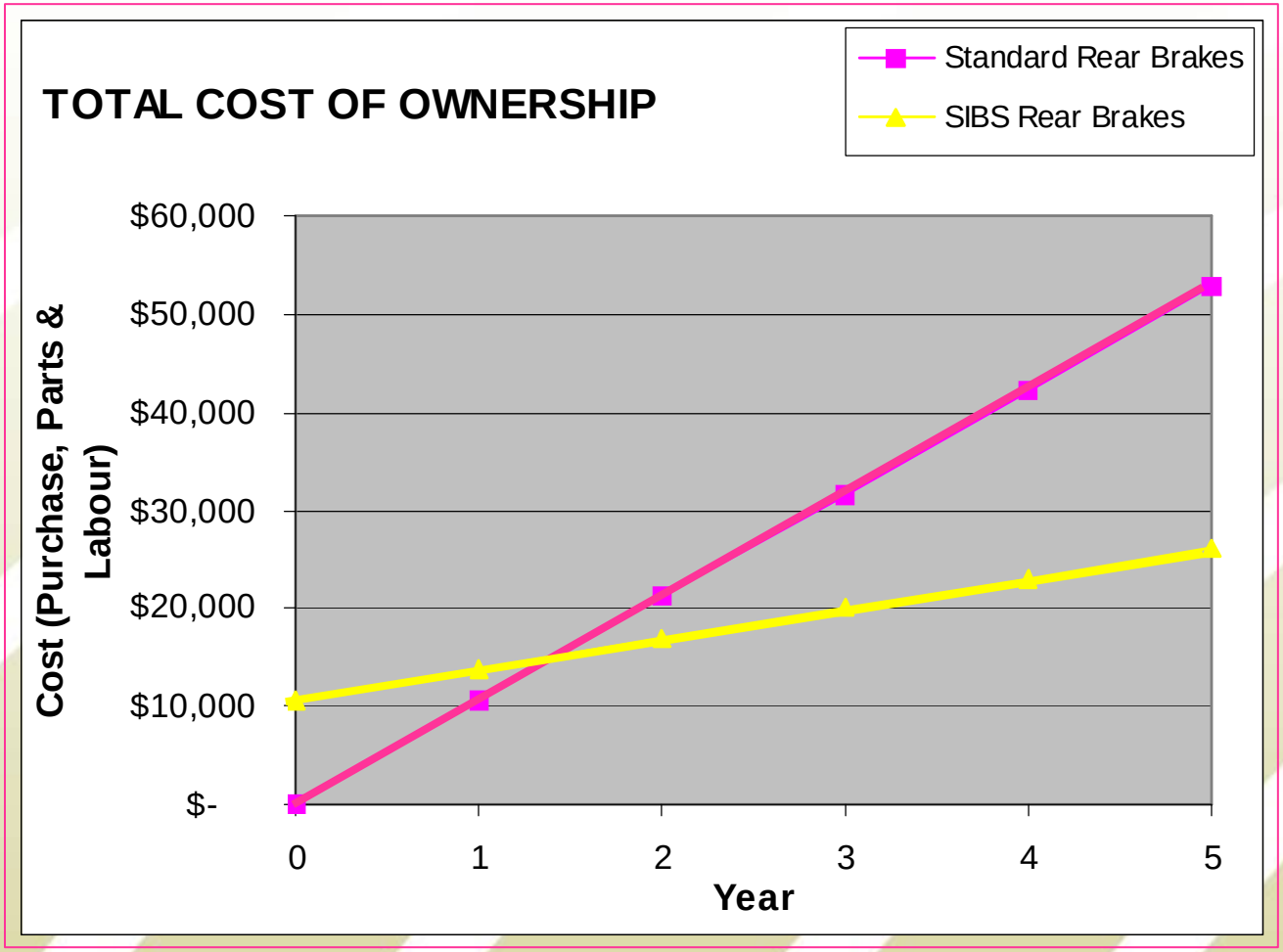
Assumptions	
Labour rate ($/hr)	$ 95

* ABT figures based on feedback from various sites – not Xstrata specific

Total Cost Of Ownership

TOTAL COST OF OWNERSHIP - Initial purchase cost, Installation, Spare Parts & Labour

Year	0	1	2	3	4	5
Standard Rear Brakes	$ -	$ 10,560	$ 21,121	$ 31,681	$ 42,242	$ 52,802
SIBS Rear Brakes	$ 10,650	$ 13,756	$ 16,863	$ 19,969	$ 23,075	$ 26,181



CONCLUSION

- ABT responded to a customer's requirement made the investment and developed an improved light vehicle solution that is now available to all customers.
- As ABT is the designer, developer and manufacturer of the SIBS it is in a position to customise or develop improved unique solutions to meet the specific needs of customers.
- The Xstrata Zinc example demonstrates a cooperative approach the will contribute to improved mine safety globally.

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