Improving the Operational Safety of Road Going Heavy Vehicles in Mining Operations

A Case Study

QUEENSLAND MINING INDUSTRY

HEALTH & SAFETY CONFERENCE

22nd to 25th August 2010

Townsville

ABT
Advanced Braking Technology Ltd

Ken Johnsen

CEO

Advanced Braking Technology Ltd

ABT is a leading supplier the SIBS fail safe braking systems for light, medium and heavy vehicles – improving safety and productivity.

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A Constant Concern!

Safety alert

Mining and quarrying

Mines Inspectorate

No. 150, 20 September 2006

Park brake failure—truck rolls away

Mine type
All mine types.

Incident
An unattended, partly loaded bulk explosives truck was parked with its engine running. The driver had applied the park brake before disembarking and was walking away from the truck when he noticed it moving. While the truck was rolling away he climbed back in the cab and stopped the truck by applying the foot brake. The truck had travelled about 20 metres and ended up with its front wheels suspended over the edge of a 2.5 m drop.

Equipment
Iveco Acco 2350G truck.

Hazard
Uncontrolled movement of a vehicle.

- The driver's understanding of the truck's braking system was inadequate.
- Climbing into the cabin of a runaway vehicle is dangerous and can result in serious injuries, or worse.
- The designated area in which the truck was parked was not suitably designed to prevent vehicles rolling away in the event of a park brake failure.

Recommendations
Truck operators ensure:

- drivers of trucks with similar park brake levers are aware of the design weakness and that they double-check the lever is locked in position when parking
- the "brake not applied" alarm works regardless of the ignition position
- risk controls—including parking procedures and the design of designated parking areas—adequately

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ABT's Product Applications

SIBS – Sealed Integrated Braking System

Light Vehicles

Wheel End

Fail - Safe Brakes

Service Trucks

Special Purpose Vehicles

Driveline

Fail - Safe Brakes

Heavy Rigid Vehicles

Today's Presentation

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The Identification of the Need

March 2007

- Truck Driver Killed in Concrete Truck in WA mine (NB- no findings handed down)
- ABT considers SIBS may assist in reducing the risk of runaway heavy trucks
- Considers a fully independent “brake of last resort” could aid in risk mitigation

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Stakeholder Consultation

June 2007

- Wide group of interested parties including WA - Mines Inspectors brought together
- Preliminary support for initiative and scope of project defined
- Concept design put forward

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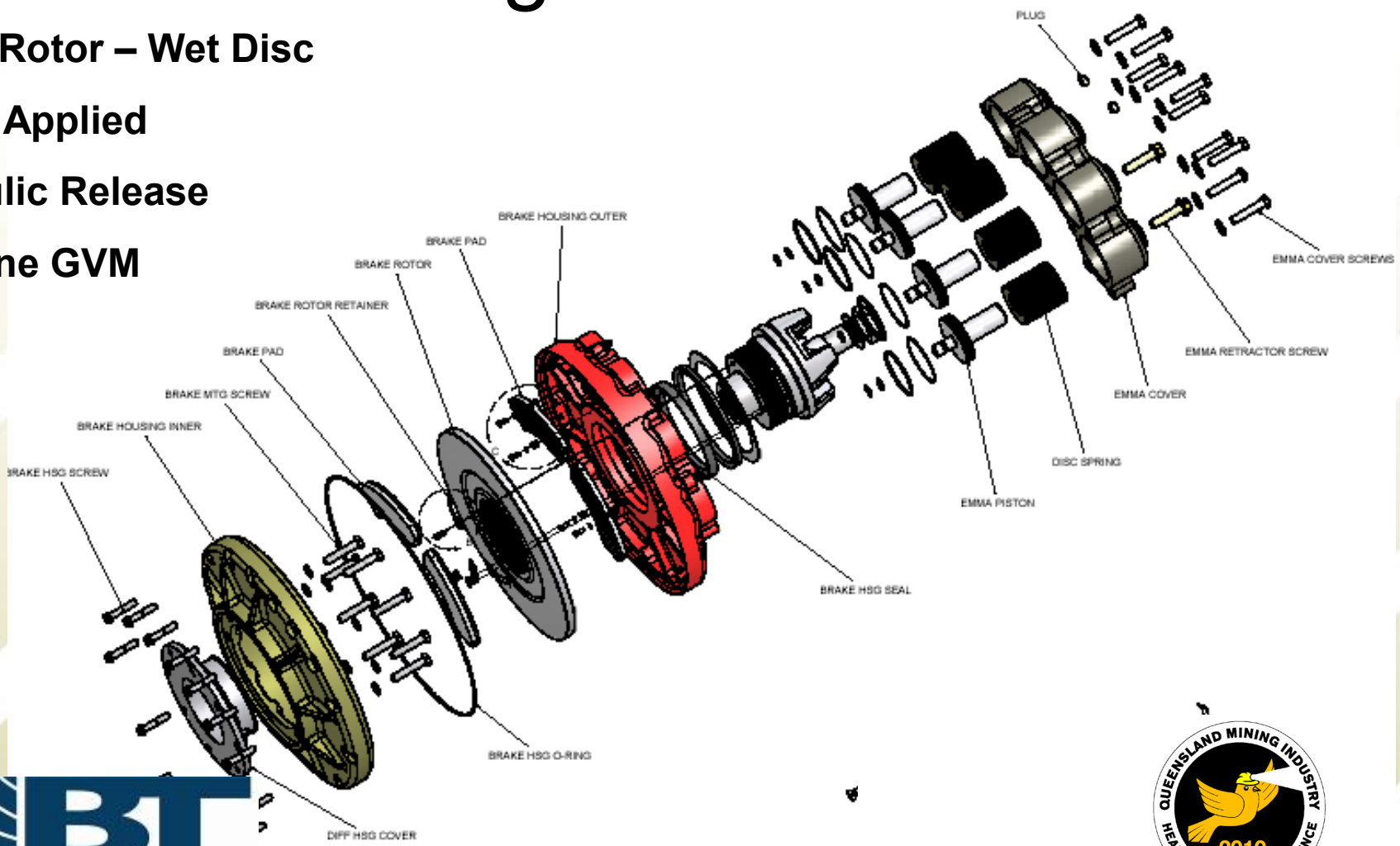
Agi Brake

- **Single Rotor – Wet Disc**
- **Spring Applied**
- **Hydraulic Release**
- **30 Tonne GVM**



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Design Brief (1)

- Spring-applied-hydraulic-release SIBS brake.
  (No service brake function included)
- Autonomous Emergency Brake requiring inspection after any incident.
- Fitted to the input side of the rear diff on single or tandem axle vehicles.
- Single axle vehicles to be fitted with non spin/limited slip differentials.Tandem rear axles to engage inter-axle diff lock at the same time as the brake
- Can be pre-assembled onto a service exchange diff to reduce vehicle downtime.
- Hydraulic & electrical components IP rated to withstand the harsh underground environment.

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Design Brief (2)

Torque requirement:

- Static and dynamic torque to meet or exceed relevant standards:
  - AS2958.1: Earth-moving machinery – Safety Part 1: Wheeled machines – brakes), and
  - SABS1589 The braking performance of trackless underground mining vehicles.
  - ADR 35/03 Section 7.7 Laden Secondary Brake Test - deceleration required 1.8m/sec^2 from 40km/hr
- Static: to hold vehicle on 32% slope (17.7 degrees)

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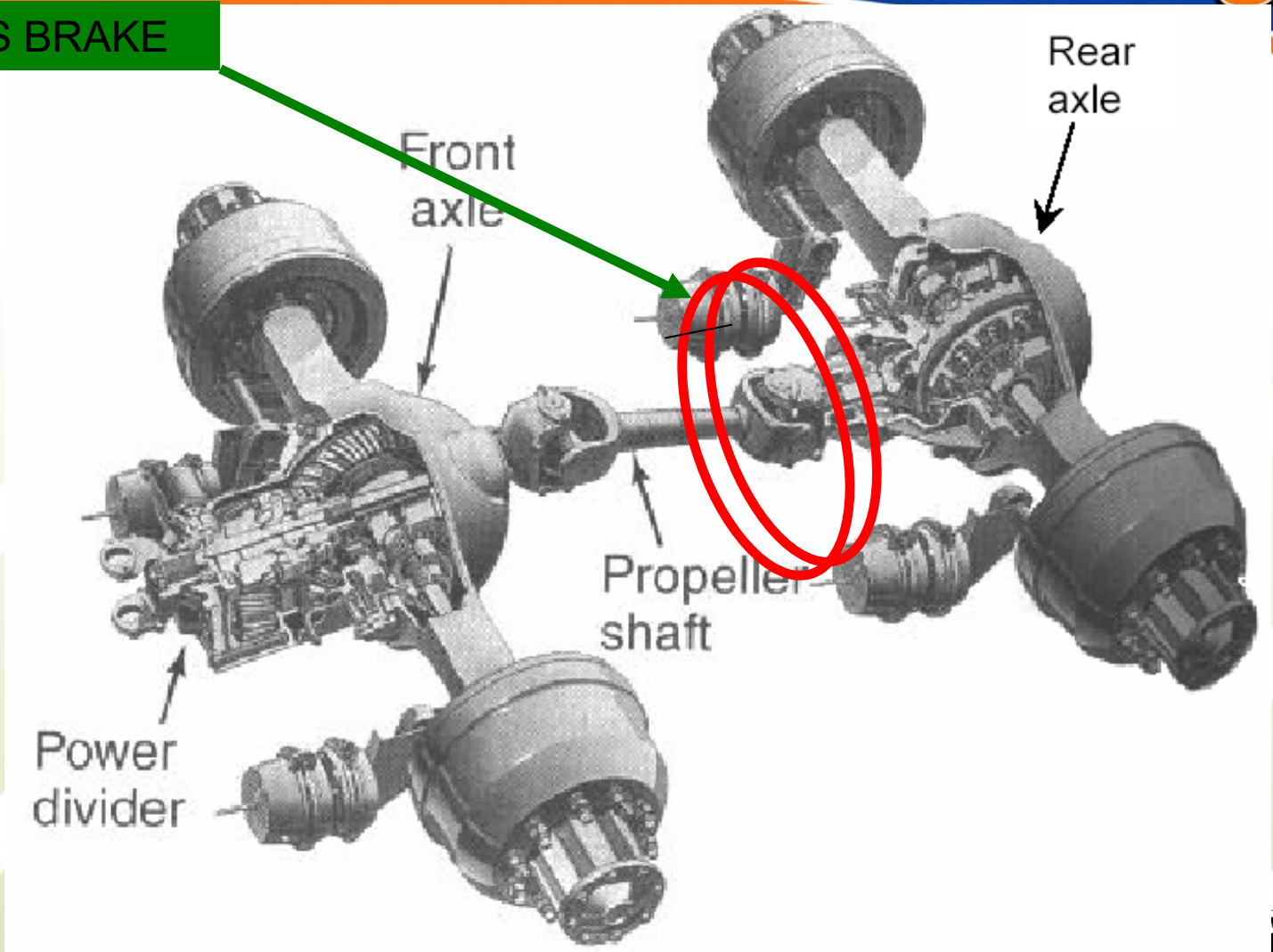
SIBS BRAKE



Project Consortium Established

August 2007

- Two stage project proposed
  - Stage 1 – Feasibility Study
  - Stage 2 – Development Project
- Consortium members
  - Barminco
  - HWE
  - Argyle Diamonds (Macmahon support)
  - Holcim (aka Readymix, Rinker, Cemex)
  - ABT

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Stage 1 – Feasibility Study

October 07

- Feasible in terms of available torque and installation issues
- Meritor axle selected common to Mack, Sterling, Isuzu, Iveco
- Capable of stopping truck from 30kph on typical decline SABS 1589 as used defacto standard
- Potentially a “single use” brake – inspection after dynamic application
- Development and production costs estimated
- Consortium approves Stage 2

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Stage 2a – Detailed Design

- New design based on an existing product
- Totally autonomous brake independent of service and existing emergency brake
- Stand alone actuation and release
- “Pancake” design means no prop shaft modification
- 3 prototypes machined from billet cast iron

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First Test Truck

Stage 2b – Initial Testing

- Holcim Truck fitted with brake
- Tested at Red Hill quarry
- Met design criteria
- Demonstrated “multi-stop” capability – originally considered single use
- Confirmed requirement for diff lock/inter axle lock
- Signed off for in-field trial June 2008

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20.08.08 - Gosnells Quarry

Test 2

GVM 19,150kg
Target speed 25-30 Km/h
Conditions - Slope 12% - Dry
Inter-axle Diff lock - Off

Stage 2c – Field Testing

August 08

- Holcim truck put into service at Golden Grove
- Weekly testing recommended
- Strip down evaluation after 3 months after material issue associated with prototype method
- Issue rectified and truck went back into service
- Weekly dynamic testing changed to drive away test
- Decision taken to manufacture a batch of 6 brakes using cast components and production suppliers
- First truck now been in service 2 years

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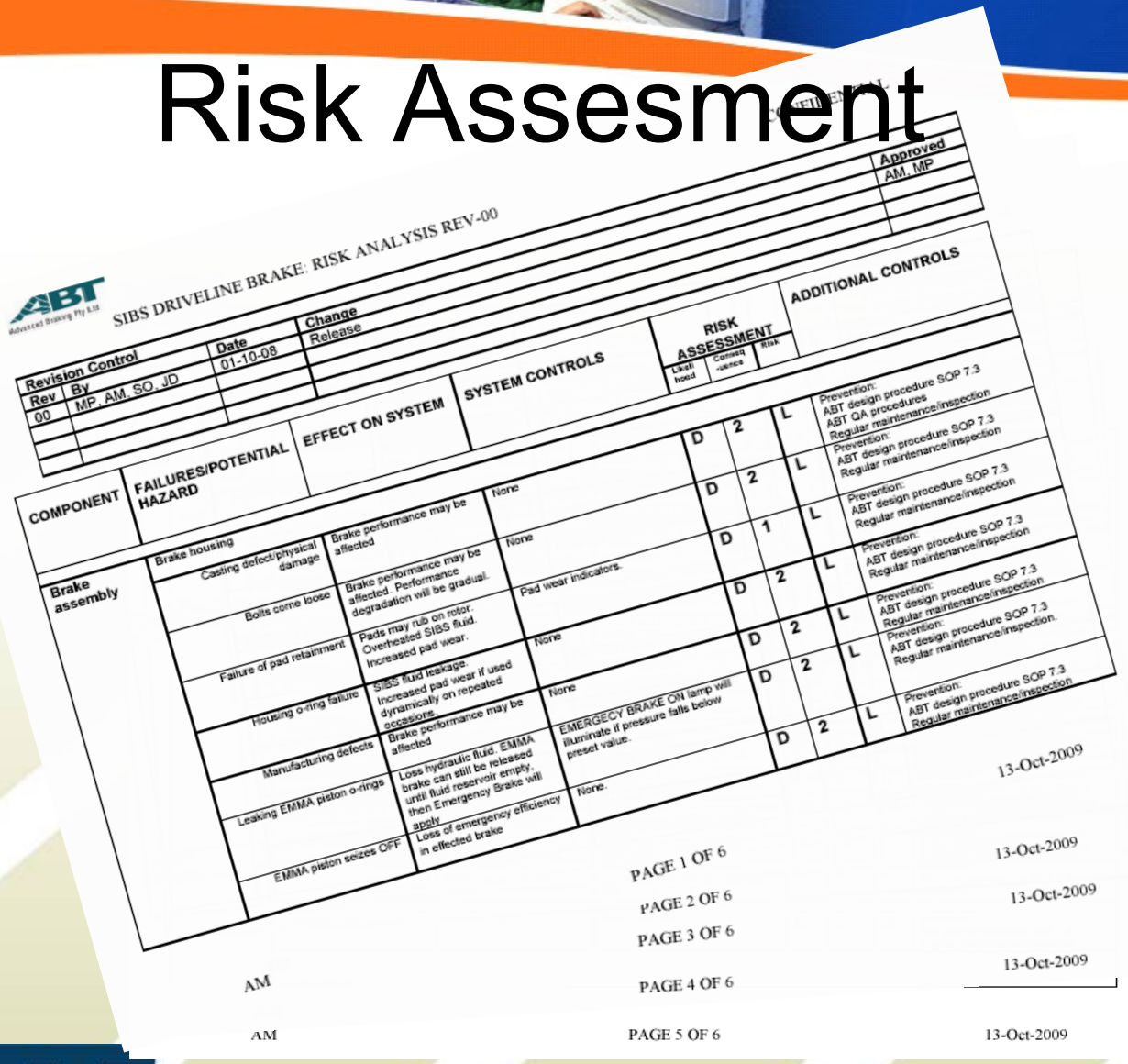
Risk Assesment



SIBS DRIVELINE BRAKE: RISK ANALYSIS REV-00

Revision Control			Change		Approved
Rev	By	Date	Release		AM, MP
00	MP, AM, SO, JD	01-10-08			

COMPONENT	FAILURES/POTENTIAL HAZARD	EFFECT ON SYSTEM	SYSTEM CONTROLS	RISK ASSESSMENT Likelihood	Consequence	Risk	ADDITIONAL CONTROLS
Brake assembly	Brake housing Casting defect/physical damage	Brake performance may be affected	None	D	2	L	Prevention: ABT design procedure SOP 7.3 ABT QA procedures Regular maintenance/inspection
	Bolts come loose	Brake performance may be affected. Performance degradation will be gradual.	None	D	2	L	Prevention: ABT design procedure SOP 7.3 Regular maintenance/inspection
	Failure of pad retainment	Pads may rub on rotor. Overheated SIBS fluid. Increased pad wear.	Pad wear indicators.	D	1	L	Prevention: ABT design procedure SOP 7.3 Regular maintenance/inspection
	Housing o-ring failure	SIBS fluid leakage. Increased pad wear if used dynamically on repeated occasions.	None	D	2	L	Prevention: ABT design procedure SOP 7.3 Regular maintenance/inspection
	Manufacturing defects	Brake performance may be affected	None	D	2	L	Prevention: ABT design procedure SOP 7.3 Regular maintenance/inspection
	Leaking EMMA piston o-rings	Loss hydraulic fluid. EMMA brake can still be released until fluid reservoir empty, then Emergency Brake will apply	EMERGECY BRAKE ON lamp will illuminate if pressure falls below preset value.	D	2	L	Prevention: ABT design procedure SOP 7.3 Regular maintenance/inspection.
	EMMA piston seizes OFF	Loss of emergency efficiency in effected brake	None.	D	2	L	Prevention: ABT design procedure SOP 7.3 Regular maintenance/inspection

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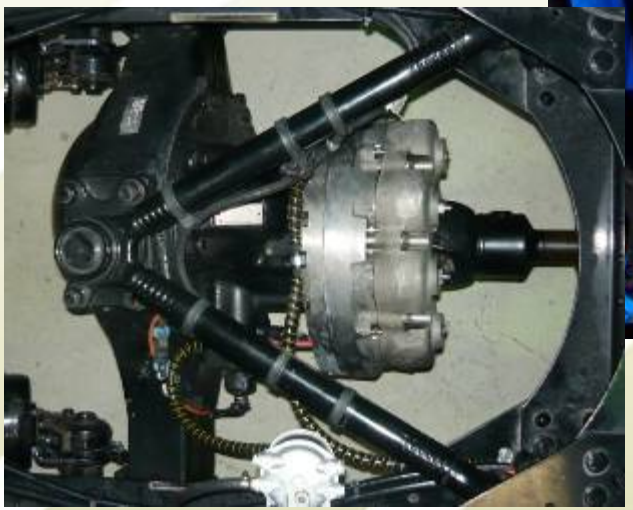
The End Product



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Latest Install

In Cab Control Box

Stand Alone Hydraulics

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Commercial Release

- Holcim and Barminco began roll out at specific locations and other customers have followed
- Trucks fitted with base design
  - Isuzu
  - Sterling
  - Mack
- Variants designed and fitted to
  - Hino (several model)
  - Isuzu (several models)
  - MAN
- 17 trucks in service
- Qld Transport Approved (“blue plate”)

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Current Applicability

- Majority fitted to Concrete Agis
- Explosive trucks
- Water trucks – similarly loaded to Agi

Next Best Alternative

- Purpose built mine vehicle with integrated SAHR brake costing in excess of $600k

Future Applicability

- Can be adapted to a wide range of on and off road vehicles

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Conclusions

- Recognition of the need
- Involvement of key stakeholders
- Comprehensive design phase
- Extensive product testing supported by stakeholders
- End product exceeds expectations
- Adaptable to a wide range of vehicles
- Consortium approach arrives at a cost effective solution to improve heavy truck safety in mining environments

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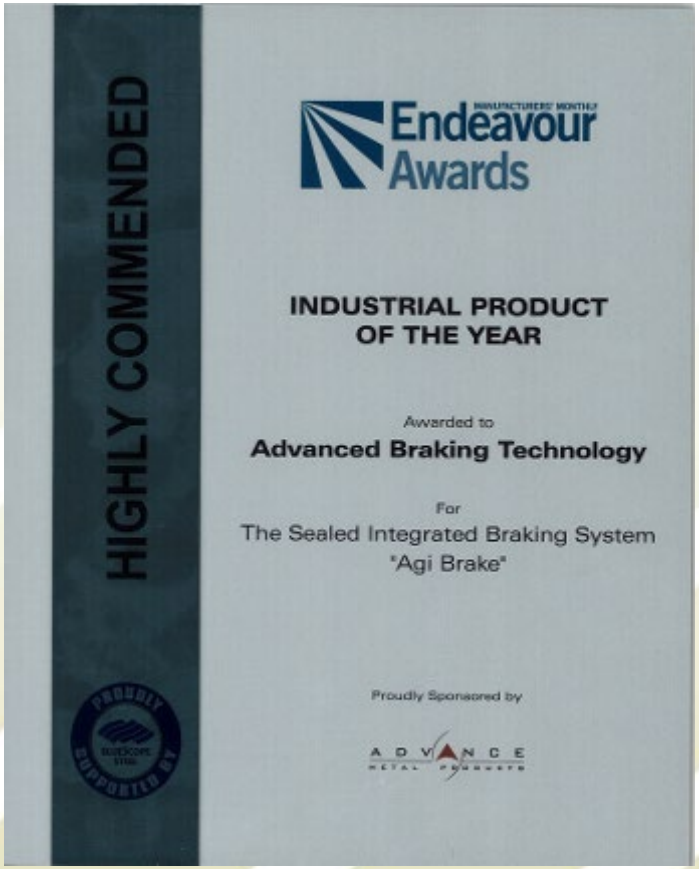
Recognition

May 2010

- Highly Commended
- Industrial Product of the Year
- Manufacturers Monthly Endeavour Award
- Runner-up to Austal's $80 million ferry



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Questions

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