NSW Minerals Industry OHS Conference 2008

Stream - Equipment Design

A case study of two NSW DPI incident investigations and the results from testing conducted on a winder haulage rope and chain components

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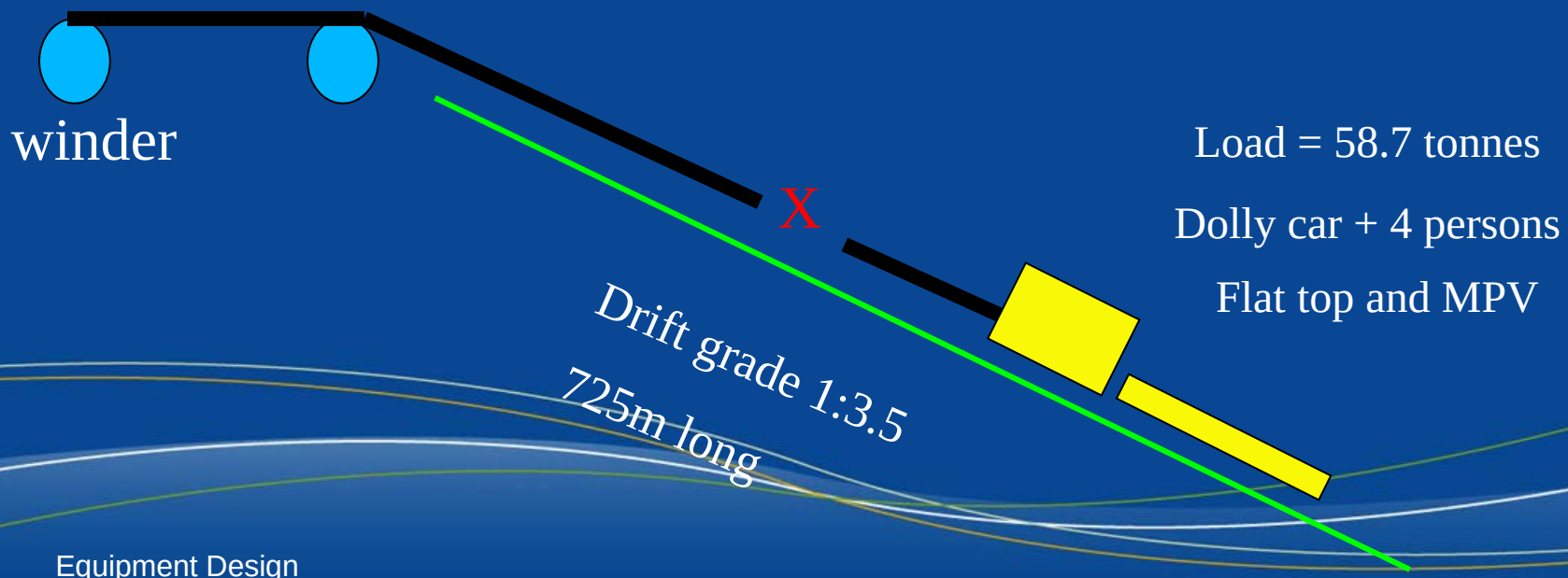
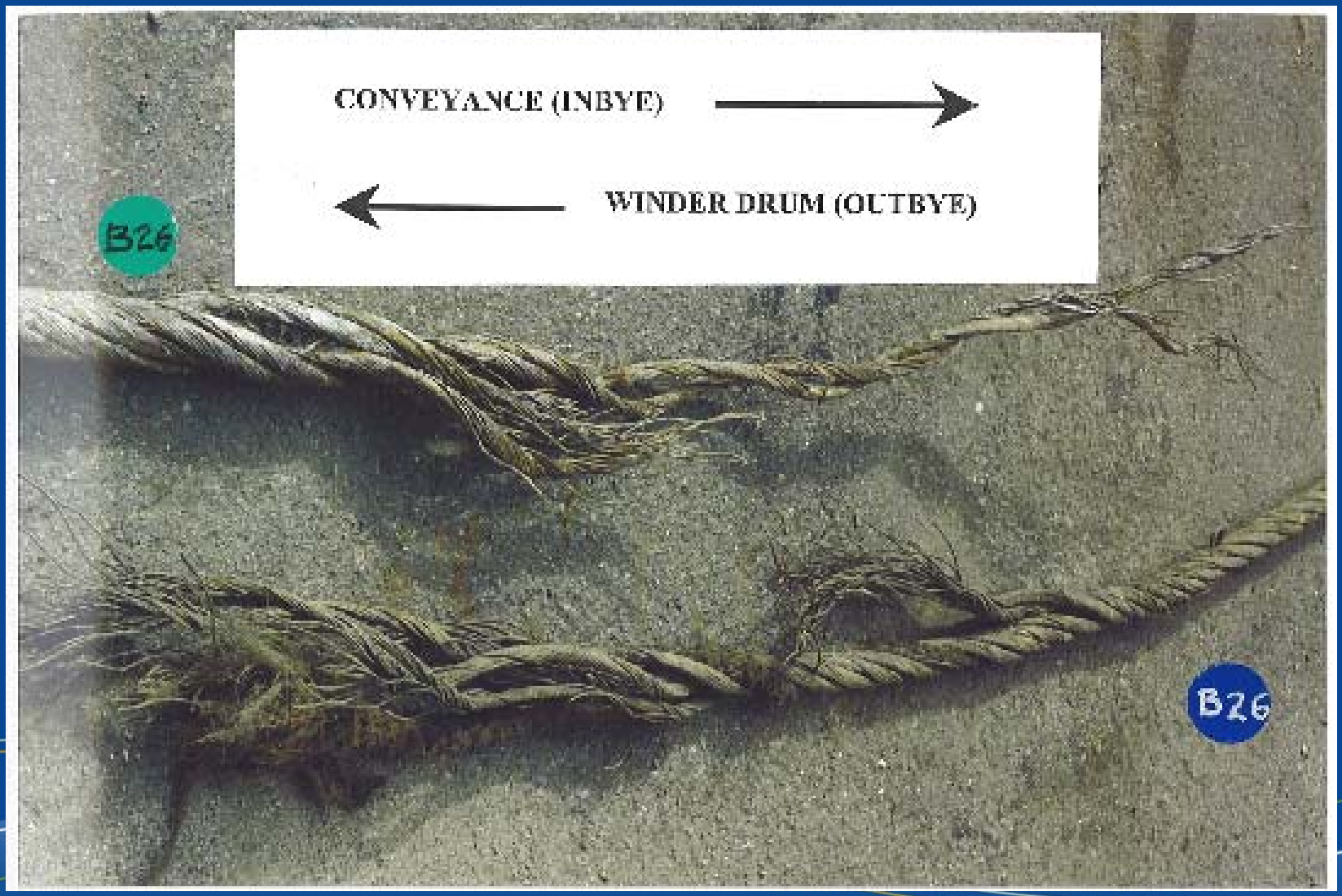
Case Study One – Failure of a Winder Haulage Rope

- Incident Date 6 May 1999 the 52mm drift haulage rope broke after being in service for 15 months
- Rope rated at 1828kN (186 tonnes)
- 80 t capacity winding system



Failed Haulage Rope



Consequence of Failed Rope

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Longwall chock
chock carrier
MPV travelled
40m from flat top

Tyre tread cut from tyre casing
as ejected from flat top

Non Destructive Testing

- Non destructive testing
  - Inbye 90m of rope NDT
  - Outbye rope NDT examined at wire rope plant
- LMA is not directly proportional to actual loss of strength
- Outer wires contribute 57% to 66% of total strength of wire rope

Photograph No. D26 – NDT set-up

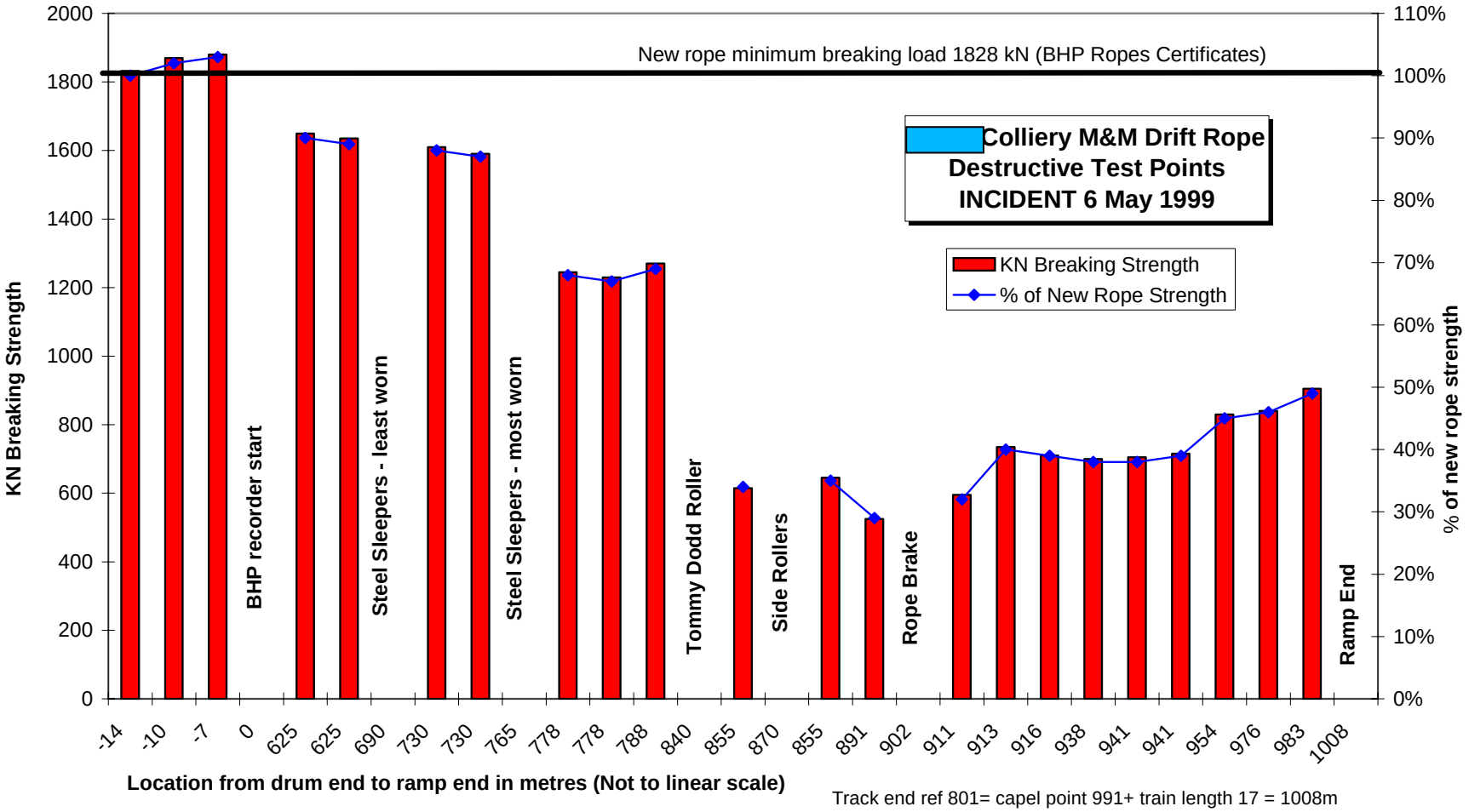
Destructive Testing

- Destructive testing
  - Resin end testing
  - Grip testing
- Relationship between NDT measured LMA and loss of actual strength
- Effects of obstructions in drift were clear

Photo No. 1Y/1 - Rope sample before testing

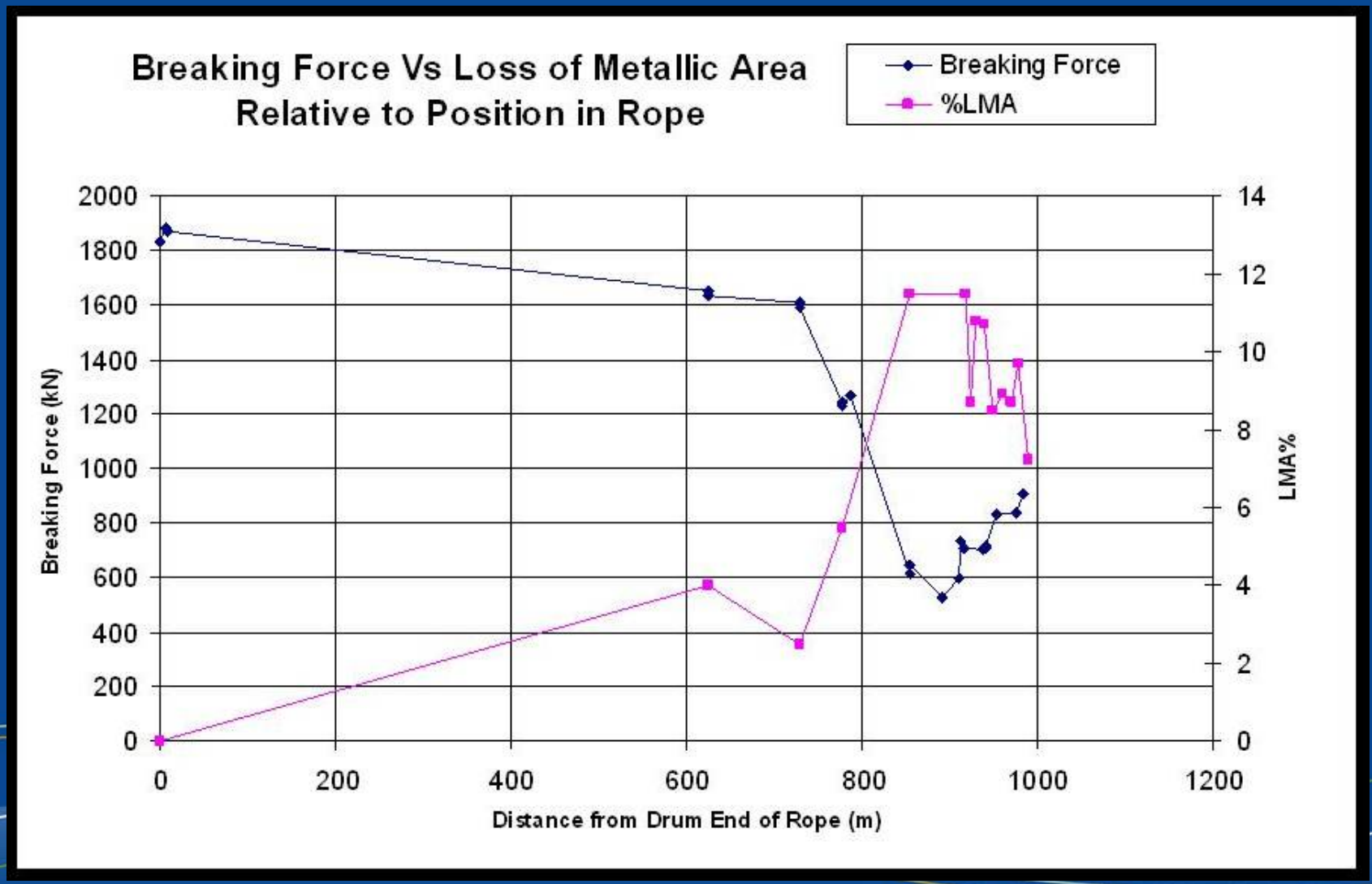
Phot No. 1Y/2- Rope sample after testing

Destructive Test Results



Track end ref 801= capel point 991+ train length 17 = 1008m

Breaking Force Vs LMA



Wire and Rope measurements

- Rope Diameter Measurements
  - Using diameter loss to identify strength is not considered accurate
  - Significant diameter loss may occur after being placed in service due to bedding of rope components

- Individual Wire examination and Analysis
  - New rope and 8 samples of broken rope were chemically and microstructure analysed
  - Individual wires tested for tensile strength, torsion and reverse bend cycles as per AS 3569-1989

Case One Recommendations

- Publicise the DPI report
- Encourage regular audits of winders and wire ropes by experts
- AS 4812 was published in 2003.
- Encourage use of auto systems to limit maximum loads on ropes to an envelope suitable for the load.

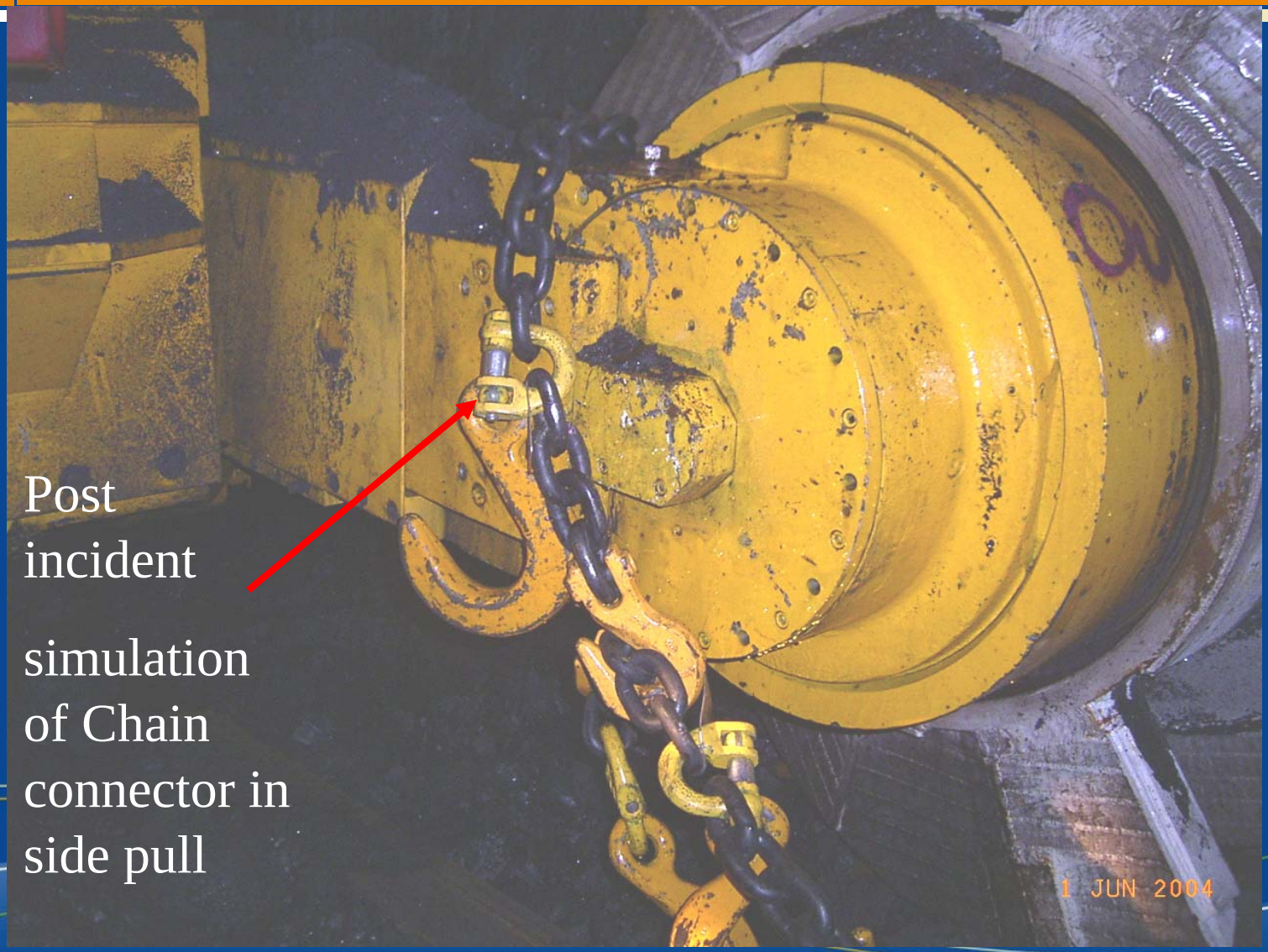
Case Study Two

Failure of a Chain Connector

Case Study Two – Failure of a Chain Connector

- Incident Date 28 May 2004
- Underground coal mine installing a longwall
- Two 1.8m length chain sets reeved around a longwall shearer ranging arm
- 20mm herc alloy chain assembly failed at the connector
- Connector placed in side loading
- Components rated at WLL 9.8 tonne in reeved pull

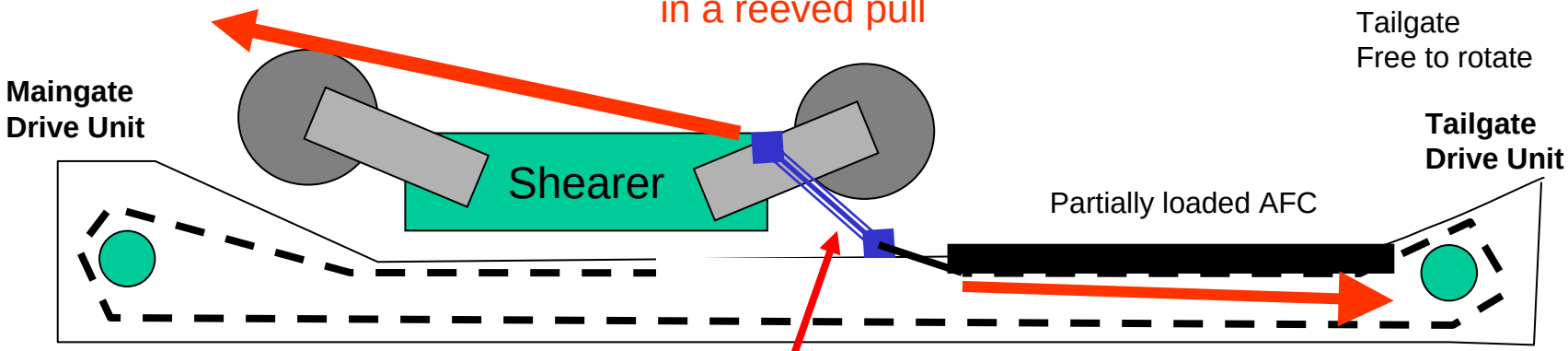
Chain connectors placed in side pull



Effective forces at time of incident

36 tonne max.
pull by shearer

Chain sling assembly
WLL of 9.8 tonne
in a reeved pull



Chain Component Failure

Resistance of 269 tonnes
Maingate drive held
Stationary by brake system
1320 kN per strand

Connector straight pull test

- Ultimate load 470kN 47.9 tonnes
- Pin sheared into 4 pieces
- Legs intact and deformed

Connector side pull test

- Ultimate load 236kN 24.1 tonnes
- Failed connector body near eye
- 52% less than AS 3766-1990 requirement (in straight pull)

Connector arm failed. Similar failure mode to connector involved in the incident

Case Two Recommendations Summary

- Standards of Mechanical Engineering practice
- Supervision and training
- Fatigue management
- Original Equipment Manufacturers (OEM) and Suppliers of Lifting and Pulling Mining Equipment

Standards of Mechanical Engineering practice

- Chain sling arrangements in Australian Standards to be modified to reflect best practise .

- *"Assemble only one chain or fitting to each Hammerlock type body half."*

- Identify working load limits (WLL) of all lifting and pulling equipment

Supervision and Training

- Development of a mining industry certified competency based training course.
- Ensure clear lines of authority
- Contractor Management systems to clearly define the scope of work and supervisory role of the contractor.

OEM and suppliers of lifting and pulling equipment

- OEM to assemble chains with only one load bearing component on any one end of a connector
- OEM/Suppliers to supply adequate instructional documentation for assembly, installation and safe use of equipment supplied.
- OEM/Suppliers to identify pulling forces and weight of equipment supplied.

Lessons Learned

When mines are preparing lifting and pulling work procedures they should take the opportunity to:

- ensure compliance with Working Load Limit (WLL) of pulling and lifting equipment.
- ensure information is readily available at the work site to identify forces applied to pulling and lifting equipment.
- ensure a competent person supervises and takes responsibility for all pulling and lifting tasks.

Response by NSW DPI

- Safety Alerts published for both incidents
- Conducted an industry seminar on winder systems
- Ongoing Audit of powered winding systems through to 2009
- Consultation with Australian Standards Committees, OEM’s and mining industry
- Legislative changes incorporating design and plant registration for winding systems

DPI published reports

- CD available free of charge
- CD contains all reports
- Contact DPI publications – Maitland
- www.dpi.nsw.gov.au/minerals/safety