



Mines Safety Bulletin No. 102

Subject: Addressing the potential for mobile (pick-and-carry) cranes to topple sideways

Date: 21 December 2012

Summary of hazard

Modern crane designs are moving towards more compact arrangements of the boom support structures. Under load, mobile cranes (i.e. pick-and-carry cranes) can topple sideways as well as pitch forward largely due to the movement in the boom support structures with induced side loading. Mobile cranes with extended and elevated booms present a particular hazard in this regard, especially when working with heavier loads, typically at load radii near the minimum specified in the manufacturer's tables.

Contributory factors

- Mobile cranes at mine sites are often used on uneven ground. The safe margins for operating parameters may not be known by crane operators, and can be adversely affected by small variations in ground conditions, exacerbated by a swinging load and the side loading from prevailing winds.
- The applicable Australian Standards do not require experimental confirmation of the sideways stability of pick-and-carry cranes when verifying designs, and no acceptance thresholds are specified.
- The dominant moments (i.e. turning effect that a force has) that induce sideways toppling result from sideways boom and rope movement during tramming. The combined effects can be greater than those experienced during controlled static lifts.
- The process of crane registration does not result in the verification of sideways crane stability.
- Mechanical wear and tear and structural modifications can lead to cracks and embedded flaws that are difficult to detect during periodic crane inspections. The hydraulic systems are sometimes modified during the life of the crane.
- Currently, periodic inspections do not require scrutiny of sideways stability. Also, mobile cranes are not usually inspected in the field under their normal operating conditions.

Recommendations

A more rigorous approach when assessing the safe operating conditions for mobile cranes will help reduce the potential for sideways-toppling accidents in the field.

Manufacturers and suppliers

- Crane designers, original equipment manufacturers (OEMs) and suppliers should assess the risk of sideways loading, through a voluntary "type approval" system, so that new and existing mobile cranes can be validated or certified.
- Side loading tests should establish the reference values for sideways boom movement under the safe working load at reference conditions with high boom angles and a fully extended boom configuration, and including articulation as appropriate

Mine manager

- Given the observed sensitivity to sideways loading, the safe system of work for mobile cranes should be reviewed and revised to ensure it is sufficiently robust. Where warranted by the risk assessment, consider an appropriate voluntary side exclusion zone.
- In addition to the periodic inspection regime required by legislation, consider an asset integrity management system using risk-based decisions to plan inspections and maintenance.
- A proactive maintenance program should be implemented to address excessive sideways movement of booms due to wear and tear and changes to structural integrity.

Operators

- The factors to be considered when identifying the risk assessment for each lift include:
 - heavier loads
 - smaller radii
 - extended boom
 - moving across uneven ground
 - wind velocity.
- Review the current risk assessment for the crane in use to determine whether the margins for safety are adequate.

Additional information

Australian and International Standards, available at www.saiglobal.com

- AS 1418.1:2002 Cranes, hoists and winches – General requirements
- AS 1418.5:2001 Cranes, hoists and winches – Mobile cranes
- AS 2550.1:2011 Cranes, hoists and winches – Safe use – General requirements
- ISO 4305:2000 Mobile cranes – Determination of stability
- ISO 4302:1994 Cranes – Wind load assessment

Resources Safety, available at www.dmp.wa.gov.au/ResourcesSafety

- Evaluation of asset integrity management system (AIMS) – guide

Note: Although issued for petroleum operations, this guide has general application to the mining industry.



Simon Ridge

STATE MINING ENGINEER