



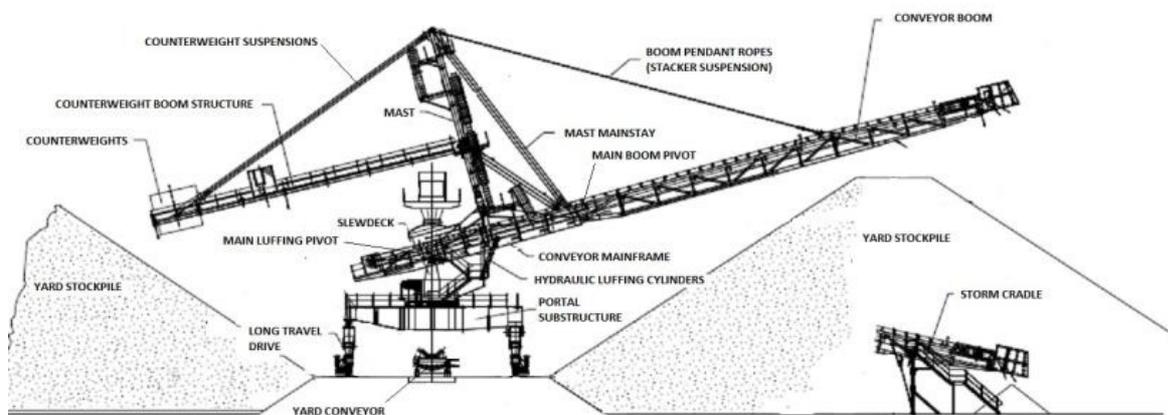
Mines Safety Bulletin No. 128

Subject: Isolation issues with rail-mounted stackers

Date: 25 November 2015

Background

Rail-mounted stackers typically consist of a pin-jointed boom and counterweight assembly that relies on suspension ropes (pendants) and rigid stays for structural stability. The stacker's position is maintained by hydraulic luffing cylinders, a slewing drive system and long-travel drives.



Typical rail-mounted stacker configuration

The conveyor and counterweight booms are supported at a main luffing pivot on the slewdeck. This allows the entire assembly to luff under the action of two hydraulic luffing cylinders, as well as slew under the action of a slewing drive system.

Counterweights can be configured such that, if the hydraulic luffing cylinders fail to hold the stacker at the required luffing angle, the stacker will slowly luff up and away from the stockpile under the action of the counterweights.

Recently, two potentially serious incidents during shutdowns have raised concerns about the operation and isolation of rail-mounted stackers. On both occasions, workers located on the machine and in the vicinity had to evacuate when isolation procedures failed.

On one occasion, there was an unexpected, uncontrolled movement of the counterweight boom and conveyor boom structures while both boom pendant ropes were being replaced. The counterweight boom crept down by about 15° of arc over a period of nine minutes. Although parked on a supporting tower, without the boom pendant ropes to stabilise it, the conveyor boom pivoted at the main boom pivot as the counterweight boom dropped.

On another occasion, there was an unexpected, uncontrolled movement of the conveyor boom while workers were replacing belt rollers on the boom conveyor. The conveyor boom luffed upwards from a near-horizontal position to its fully raised position under the action of the counterweights. On its way up, the conveyor boom struck the sheave block of a mobile crane.

Summary of hazard

As well as general machinery hazards, rail-mounted stackers have unique hazards associated with their stability. There is the potential for:

- uncontrolled luffing movement of the boom assemblies (conveyor and counterweight) if the hydraulic luffing system fails to hold the load
- catastrophic structural collapse if suspension ropes, fixed stays or pin joints either fail or are removed
 - during maintenance activity
 - out of sequence without appropriate controls
- overturning if the machine is not correctly balanced with counterweights in accordance with the designer's intent
- overturning under abnormal loading conditions
- derailment from long-travel rails.

For people on or near these machines, there is the potential to be struck or crushed by moving or falling parts. In the event of a catastrophic structural failure, there is often little warning and usually insufficient time to escape the vicinity. There may also be further effects if the uncontrolled movement or failure interacts with other plant or structures.

Contributory factors

- The isolation procedures need to recognise and control all sources of hazardous energy, including gravitational potential energy. For example, the consequences of isolation failure may increase when inaccurate balance weight information is used.

Note: Although not identified as a significant contributory factor for these incidents, the isolation procedures had not been based on accurate balance weight information (e.g. derived from commissioning records or current hydraulic luffing trend information for the stackers).

- Solely relying on a single hydraulic system to resist luffing moment from an otherwise unrestrained load or loads is not a reliable method for isolating the machine from uncontrolled luffing movement.
- The hydraulic relief valves of the luffing system involved in both incidents cannot be tested in situ, making it impossible to confirm that the set-points (critical to the luffing functions of the machine) are correct and have not been tampered with.

Note: It was reported for one of the incidents that locking tabs had been removed from the relief valves and they appeared to have been adjusted. This may have allowed hydraulic oil from the luffing cylinders to relieve to the reservoir, preventing them from holding the load.

Actions required

The following actions are recommended for rail-mounted balanced structures to address the potential for unexpected and uncontrolled movement of counterweight and conveyor booms.

Isolation

A "hydraulic lock" is not a positive isolation. Additional controls, such as those listed below, should be considered when isolating the machine.

- When changing pendant or suspension ropes, or rigid stays that support a boom in a balanced position, consider if it is practicable to replace one at a time while others are left in place to continue to support the boom. Such a methodology should be used in conjunction with additional forms of positive isolation to avoid any uncontrolled movement.
- Ensure the machine is correctly balanced to minimise the required stabilising force from the hydraulic luffing cylinders, supporting towers or other means of isolation.
- Use a supporting tower (e.g. storm cradle) that has been adequately designed, installed and maintained as specified by the stacker manufacturer.

Maintenance

- Competent persons should test, adjust and lock hydraulic relief valve set-points. Use appropriate tools and equipment in accordance with the manufacturer's instructions and original equipment manufacturer (OEM) design requirements.
- Pressure relief valves that are corroded, damaged, incorrectly installed, interfered with or have had their tamper proof seal or lock removed should be replaced with correct valves that have been set, tested and certified by a competent testing authority to OEM requirements.

Stability

- At the commissioning stage, records should include a weight check. After a machine is erected, AS 4324.1 requires the "as-built" mass and centre of gravity of the machine to be determined. It is not unusual for the calculated mass of the machine to be an under-estimate of the final actual. This may affect stability and the mass of counterweights required. AS 4324.1 specifies that if the as-built mass exceeds the designer's calculated mass by more than 5 per cent, then the stresses in the machine should be re-checked.
- After commissioning, if recent luffing trend data (luffing cylinder pressure) is available from the control system memory, this should be used to check the balance condition of the machine.
- Use up-to-date balance data when designing alterations to the machine.
- Check that the balance condition of the machine has not changed before competent persons:
 - undertake risk assessments
 - make decisions about machine isolation
 - prior to any work that may affect stability.

Further information

- Standards Australia, www.standards.org.au

AS 4324.1 Mobile equipment for continuous handling of bulk materials – General requirements for steel structures

- International Standards Organisation, www.iso.org

ISO 5049.1 Mobile equipment for continuous handling of bulk materials – Part 1: Rules for the design of steel structures

This Mines Safety Bulletin was approved for release by the State Mining Engineer on 25 November 2015