NSW Resources Regulator

INVESTIGATION REPORT

Report into the serious injury of a mine worker on 1 February 2016 at the Sibelco Salt Ash Sand Plant

NSW GOVERNMENT Planning & Environment Resources Regulator

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Executive summary

At 12.57 pm on 1 February 2016, a 57-year-old worker fell 2.7 m from the platform of an articulated dump truck (dump truck) and suffered serious head injuries. The dump truck was on a low loader road transport truck and was being prepared to be reversed off the low loader at the Sibelco Australia Limited Salt Ash Sand Plant.

The Salt Ash Sand Plant is adjacent to sand dunes in the Stockton Bight area of Port Stephens about 20 km north of Newcastle, NSW.

The low loader was parked near the mine workshop.

The worker was readying the dump truck to reverse it off the low loader and was in the process of adjusting the truck's external mirrors. After adjusting the driver's left side mirror from a protected walkway, the worker then walked behind the dump truck cabin to the top of the right front wheel arch to adjust the off-side mirror. This side of the dump truck had no fall protection or guardrails installed.

After making the mirror adjustment the worker turned and walked toward the access steps where he fell to ground level. The worker's head hit the ground, causing a skull fracture requiring emergency surgery to reduce brain swelling. The worker's injuries included a jaw fracture, a brain haemorrhage that required secondary surgery and ongoing loss of hearing.

The worker cannot recall the incident.

Investigation findings

Human and organisational factors

Human and organisational factors are the attributes that influence our behaviour at work and include three interrelated aspects of the job, the individual and the organisation. Each aspect includes characteristics known as performance shaping factors.

Performance shaping factors are the characteristics of the task, the individual and the organisational factors that influence human performance. Performance shaping factors operate at a number of levels within the organisation and are used to determine the key factors that contribute to the likelihood of error.

Four key performance shaping factors were identified to be contributory to the incident:

- **design and modification of the plant** – the risk of falling from the dump truck was identified
- **situational awareness and assessment** – previous training and the application of working at height risk control measures were not implemented by those performing the task
- **normalisation of the risk** – working at heights with the dump truck on a low loader and the effectiveness of corporate safety management systems were not implemented at site level
- **risk management practices** – documented procedures were not implemented.

Plant

The investigation identified the following plant issues with the articulated dump truck:

- platform floor was in a degraded condition with an uneven and rusted walkway with slip treads missing and/or worn
- no fixed perimeter edge guardrail fall protection in place
- two grab rails present on the dump truck cabin body however the layout was not intuitive for a person to maintain three points of contact
- arrangement of the steps was inadequate and were not supported by hand rails
- no physical barrier or warning sign on the right side platform to either prevent access or provide information that a person should not proceed onto the platform without:
    - temporary edge protection barriers in place, and/or
    - use working at height for fixed or mobile equipment.

Systems of work

- no task assessment was created for the unloading of the dump truck to review the risks
- documented Sibelco 'working at heights' permit system was not used
- mobile access ladders were available at site but not used for the task
- mobile access systems were available at site (forklift with man cage) but it was not used
- no mobile fall arrest system was available at the site (available at other Sibelco sites)
- no fixed fall arrest system was available at the site (available at other Sibelco sites).

People and environment

- a site supervisor was present and witnessed the task
- no evidence of a personal health issue that may have caused the worker to fall
- no evidence that fatigue contributed to the fall
- no evidence of any defect with the worker's boots that may have caused the fall
- no evidence of water, mud, oil or debris on the platform of the truck
- no movement of the truck or low loader at the time of the fall.

Access rick control measures

The hierarchy of risk control measures must be considered when managing risks associated with access to mobile plant. In particular when undertaking:

- pre-start inspections including window cleaning and exterior mirror adjustment
- normal production activities
- field and breakdown maintenance
- workshop maintenance

- tasks during transportation on low loaders.

Control measures available to reduce the risk of falls from the truck include the:

- design and installation of fit-for-purpose fixed guardrails to meet Australian Standards, codes of practice and other published guidelines
- installation of physical barriers to prevent access onto platforms that did not have fixed edge protection in place
- display of signs to warn workers accessing platforms without fixed edge protection that mobile guardrails are to be used and/or mobile or fixed working at heights equipment is to be used
- use of mobile access systems, mobile steps and mobile guardrails (including forklift and man cage) to provide temporary edge protection in areas where fixed edge protection is not provided
- use of mobile or fixed fall arrest systems where access is required beyond the limitation of fixed or mobile edge protection systems or mobile steps.

Published recommendations

Industry recommendations published April 2016

Recommendations to the mining industry were published in the Resources Regulator's investigation information release, IIR16-03 Worker seriously injured in fall from articulated dump truck on 21 April 2016.

Industry recommendations published December 2016

The Resources Regulator published a safety bulletin, SB16-06 Injuries incurred from falling plant on 22 December 2016.

Contents

1. Purpose of the report

The purpose of the report is to assist the Secretary of the department, as the regulator of work health and safety at mines and petroleum sites, to understand the incident and to share information with industry and the community so that proactive steps can be taken to improve industry safety and prevent similar events from occurring.

2. Investigation overview

2.1. Major Investigation and Emergency Response Unit

The Major Investigation and Emergency Response Unit (MIER) investigate the cause and circumstances of major workplace incidents in the NSW mining, petroleum and extractives industries. The unit's role is to carry out a detailed analysis of incidents and report its findings to enhance industry safety and to give effect to the NSW Resources Regulator's compliance and enforcement policy.

2.2. Investigation scope

MIER investigators have the authority to conduct an investigation into this matter as the incident occurred at a mining workplace regulated by the department. In accordance with departmental policy, the incident automatically triggered an investigation by the MIER because it resulted in the serious injury of a worker at a mining workplace. The investigation was conducted under the *Work Health and Safety Act 2011* (WHS Act) and the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* (WHSMA).

2.3. Legislative authority to investigate

MIER investigators are appointed as government officials under the WHSMA and are deemed to be an inspector for the purposes of the WHS Act. The regulator has also delegated some additional functions to investigators, including exercising the power to obtain information and documents for the purposes of monitoring compliance with the WHS Act.

2.4. The department's information release

The Resources Regulator published an investigation information release concerning the incident on 21 April 2016.

The information release, IIR16-03 Worker seriously injured in fall from articulated dump truck provided industry with information about the incident and made safety observations concerning the foreseeable risks of workers falling from high mobile plant.

The information release identified that mine operators should review critical control measures to reduce the risk of falling from mobile plant. Mine operators were asked to review applicable work health and safety laws, SafeWork NSW codes of practice, department guidelines and Australian Standards.

The department published a safety bulletin SB16-06 Injuries incurred from falling plant on 22 December 2016.

The safety bulletin made recommendations to designers, manufacturers, suppliers and users of mobile plant concerning managing risk of falls in workplaces.

3. The circumstances of the incident

3.1. The incident

A Volvo A30 articulated dump truck had been transported to the Sibelco Australia Limited (Sibelco) Salt Ash Sand Plant from another NSW Sibelco mine, the Excelsior Quarry, on Monday, 1 February 2016. The dump truck was on a low loader road transport truck and needed to be prepared for reversing off of the low loader. A worker was folding out the mirrors when he fell 2.7 m from the off- side platform of the dump truck to the ground.

Figure 1: View from the right (off-driver's) side of the Volvo A30 A1 on the low loader truck on 1 February 2016. The two yellow numbered markers indicate the approximate location where the worker fell to the ground.

The Salt Ash Sand Plant is at Salt Ash adjacent to sand dunes in the Stockton Bight area of Port Stephens about 20 km north of Newcastle, NSW.

The worker was a leading hand plant operator and had operated similar articulated dump trucks on other occasions. This was the first time the worker had unloaded an articulated dump truck from a low loader. The worker had been on day shift for about seven hours. He was a full-time employee of Sibelco.

The worker's task was to prepare the dump truck so that he could reverse it off the low loader. There was no documented job risk assessment (JRA) created for the task of unloading the truck.

A site security camera recorded the unloading process and the incident. The recording showed that a Sibelco supervisor (operations manager) spoke with the worker before he climbed onto the dump truck. The operations manager remained in close visual proximity to the worker up until the time the worker moved across to the right hand side of the dump truck.

The low loader transport driver removed transportation load bindings from the dump truck and lowered the loader ramps. Only the worker climbed onto the dump truck. The worker was to open the inwards facing wing mirrors that were closed inwards for transport on the highway. This was so that the worker could use the wing mirrors while reversing the truck from the low loader.

The off-drivers side sliding window configuration made access difficult to fully open the off-drivers side wing mirror by hand from inside the cabin. The worker used the driver's side walkway to open outwards the mirror on that side. The driver's side platform had outer edge protection provided by a perimeter guardrail.

After opening the driver's side mirror the worker walked from the left side driver's platform in a forwards direction towards the dump truck tub (load carrying trailer body). The worker did not turn around to face the stair so as to maintain three points of contact while descending the driver's side stair. The worker then stepped off the stair and gained access through the space between the rear of the cabin and the tub.

This space was not a designated walkway on the truck. The worker did not go back down to ground level to access the right side off-driver's platform.

The worker stepped onto the off-driver side stair to access the platform. The worker fully opened the off-drivers side wing mirror from the platform and then turned around to face the tub of the dump truck. The worker then walked in a forwards direction several paces towards the top of the access stairway on the off-driver side.

The worker miss-stepped and fell feet first in a forwards direction towards the tub of the truck, from the top of the access stairway. During the fall his body rotated away from the dump truck. The worker's feet struck the top of the low loader and the momentum of his upper body and head continued to fall, during which his helmet became dislodged.

The worker's head struck the ground causing a skull fracture requiring emergency craniotomy surgery to reduce brain swelling. His injuries included a jaw fracture, a brain haemorrhage which required secondary surgery and ongoing loss of hearing.

The worker cannot recall the incident.

The incident occurred in the Salt Ash Sand Plant compound on a flat hard stand area near the workshop which previously had been used for loading and unloading mobile plant.

The ground surface was comprised of hard compacted material and was dry on the day of the incident.

There were two other workers assisting the worker with the unloading of the dump truck from the low loader. These workers were the operations manager and the contract low loader driver. Both workers confirmed that there was no movement of either the dump truck or the low loader that could have caused the worker to fall.

While there was no specific unloading location at the site for the task the incident occurred in an area that mobile equipment had been unloaded on regularly prior to 1 February 2016.

**Figure 2: View from the driver's side access of the dump truck on the low loader truck on 1 February 2016.
Note the two modified light yellow outer guardrails fitted to the walkway access areas on the driver's side of the truck.**

There were no fixed or mobile fall arrest systems available at the site.

Several mobile ladder systems were available at the Salt Ash site that was suitable for the task being undertaken.

A forklift and man cage was available at the site. The forklift and man cage could have been used to either lift the worker up to open the mirror or the man basket could have been used to provide temporary edge protection if placed against the truck platform outer edge.

3.2. Review of fatigue and medical conditions

There was no evidence of fatigue contributing to the incident.

The incident occurred about seven hours into the worker's shift. The worker began work at 6.00 am and his shift was to end at 2.00 pm.

The worker had not worked at Salt Ash site for three days before the incident. The worker had worked at the Salt Ash site for three eight-hour shifts before the three days recorded as being not at work.

The worker has no pre-existing injuries or medical conditions that contributed to the cause of the fall.

3.3. Review of personal protective equipment

The worker was wearing steel cap lace-up work boots. There was no evidence of any external damage to the boots that could potentially cause a trip. The left boot lace was in a degraded condition and the tread pattern

on the soles of the boots was worn. There was no evidence of any rips or major damage to the sole of either work boot.

3.4. Incident chronology

Pre-2014

The risk of falls when undertakings pre-start engine checks from the platform of a similar model Volvo A30 (number 2) articulated dump truck had been recognised by Salt Ash site management prior to 2014.

Salt Ash site management decided to engage an engineering company to build and install a perimeter guardrail on the truck's driver's side platform. The guardrail design was created to replicate guardrails similar to those shown in brochures of a newer model Volvo articulated dump truck.

Significantly, management considered that pre-start inspection access was not required on the off- side and therefore it was not necessary to install outer edge protection on the off- side platform of the dump truck.

Figure 3: Front view of Volvo A30 number A2 (similar to number A1) at Sibelco processing plant at Sandgate, NSW, on 11 August 2016. Showing the original version created before 2014 of the modified guardrail fitted only to the driver's side platform.

3 January 2014

Sibelco recognised the significant exposure to the risk of fall from vehicles at Sibelco sites in Australia. On 3 January 2014, Sibelco issued an internal safety alert titled *Work at heights on vehicles*. The safety alert showed that Sibelco had identified records of 46 work at height incidents when the company rules had been

broken dating from 2010 to September 2013. The safety alert recommended a number of actions required at Sibelco sites to prevent falls from height relating to vehicles.

After the issue of the safety alert, in early 2014 a Sibelco health and safety regional advisor provided working notes for Sibelco site managers to consider when completing risk assessments when working at heights on vehicles.

The regional advisor's notes highlighted:

> *'Eliminating the need for someone to access high parts of a vehicle (during loading and unloading as well as vehicle maintenance)'*
>
> *'… the need to install infrastructure to attach fall protection equipment – H.S. adviser can provide full specification for fall protection gantry's and mobile anchor point solutions'.*

8 January 2014

The operations manager of the Sibelco Excelsior Quarry emailed the regional advisor with concerns about fitting fall protection or guarding on older mobile machines. The regional advisor provided photographs to the Excelsior operations manager showing the perimeter guardrail fitted to Volvo A30 number A2 at the Salt Ash site.

19 February 2014

A Sibelco work order and other records were created for the modification to the guardrail on the driver's side of Volvo A30 number A1 (the truck involved in the incident).

5 March 2014

Volvo A30 number A1 was fitted with a guardrail on the driver's side platform. The guardrail design was similar to the Volvo A30 number A2 and constructed by a Sibelco Engineering Services employee at a total cost of $2,853 including labour and materials.

Sibelco did not produce a plant risk assessment for the hand rail modification to Volvo A30 number A1. Plant change management procedures required Sibelco Engineering Services to undertake a risk assessment for the proposed plant modifications.

23 June 2014

The Sibelco executive general manager issued a memorandum to Sibelco operations managers titled *Controls for prevention of falls from vehicles*.

The directive required operations managers to:

1. *Conduct a risk assessment of the hazard and identify where falls from vehicles could occur at your operation (review site Risk Registers or JSAs where a fall from a vehicle could occur.*
2. *Using the attached guidelines, identify physical control measures that are already in use or you will implement for each situation where a fall from a vehicle could occur.*
3. *Complete the feedback form attached and provide to your Regional Manager by 7 July 2014. In addition also provide a full list of all current projects and initiatives on sites.*

September 2014

A Sibelco project team was engaged to consult with Sibelco sites to undertake a four-stage program concerning working at heights on mobile equipment.

Working at heights equipment was purchased to reduce the risk of falling from heights on mobile equipment for 29 industrial mineral sites operated by Sibelco in Australia. Two mobile fall arrest systems were bought, however a mobile fall arrest systems was not purchased for the Salt Ash site.

Seven fixed fall arrest systems were bought, however a fixed fall arrest systems was not purchased for the Salt Ash site.

Salt Ash site bought a set of mobile steps to access tanker trucks.

This particular mobile steps was available on 1 February 2016 at the Salt Ash site but was designed specifically to gain access to open tanker truck inspection lids. It could not have been used as a temporary edge protection as the lowest possible height of the edge protection was about 3.4 m. The height of the dump truck platform on the low loader was 2.7 m.

Salt Ash site bought temporary edge protection for flatbed trucks and access steps. A forklift with man cage was available at site. Sibelco decided not to purchase mobile or fixed fall arrest system equipment.

October 2014

Site risk assessments were provided to the Sibelco working at heights project team for review. The Salt Ash risk assessment identified the use of a man cage when accessing a bulk tipper body for inspection and breakdown.

30 December 2014

A revised risk assessment for all sites including Salt Ash was completed by the Sibelco working at height project team.

10 March 2015

A Sibelco logistics manager found that employees working on equipment such as tippers or loaders had not been identified in the initial risk assessment. Management at the Salt Ash site responded that a man cage was used where no working at height solution was present. Transporting mining equipment on low loaders was not considered in the risk assessment.

11 March 2015

The Salt Ash operations manager confirmed the purchase of working at height equipment including mobile steps for accessing tanker trucks and a 1.5 m platform ladder as part of the edge protection system.

Based on the Salt Ash risk assessment, a fixed or mobile fall arrest system was not purchased for Salt Ash site because the control measure of using a man cage on a forklift was in place at the site.

29 May 2015

A capital expenditure was approved by the Sibelco project team to upgrade working at height issues identified at 21 sites. There were seven fixed fall arrest systems and two mobile fall arrest systems bought for nine other Sibelco sites in 2015. The equipment was supplied to other Sibelco sites from 14 July 2015 to 18 January 2016.

14 January 2016

Written approval was given by Sibelco management to transfer the A30 number A1 dump truck from Excelsior Quarry to the Salt Ash site for production purposes.

There was no compliance assessment documentation created for the review of the dump truck for the transfer between the two Sibelco sites. There was a Sibelco procedure that required plant to be assessed on modification or transfer.

27 January 2016

The Excelsior regional manager obtained a transportation quote for the transportation of the A30 number A1 dump truck to Salt Ash site.

The transport of the dump truck to Salt Ash was controlled by three Sibelco company-wide transport procedures. The transport procedures required that working at heights procedures were to be applied and that truck drivers were not to climb onto any part of the tipper body without providing a safe access solution, working at heights permits were applicable and that pre-work briefing conducted by the supervisor was to take place.

1 February 2016 (day of the incident)

7:30 am loading the dump truck at Excelsior Quarry

At the quarry, Sibelco employees created a job risk assessment (JRA) document for loading the dump truck onto the low loader.

The JRA identified the risk of falling from the dump truck during pre-start inspection and identified three controls to reduce the risk:

1) *Use three point of contact at all times*
2) *Use designated steps and walkway areas*
3) *Use approved platforms if necessary.*

Excelsior Quarry was allocated a fixed fall arrest system for the working at heights equipment upgrade in 2014.

A Sibelco plant operator drove the dump truck onto the low loader at Excelsior Quarry. The low loader driver closed the off-side mirror by opening the sliding window by hand in the cabin. The mirrors were closed inwards to comply with NSW road transport permit width requirements.

12:43 pm unloading the dump truck at Salt Ash Sand Plant

The low loader and dump truck arrived at the unloading point at Salt Ash site and were met by the Salt Ash operations manager. Vehicle unloading had taken place at the same location on other occasions.

12:50 pm

The worker met the operations manager and a conversation took place. There was no direct verbal consultation with the low loader driver at this time.

There was no specific documented risk assessment or JSA created for unloading the dump truck from the low loader.

12:54 pm

The worker climbed up onto the driver's side of the truck located on the low loader and entered the cabin.

12:56 pm

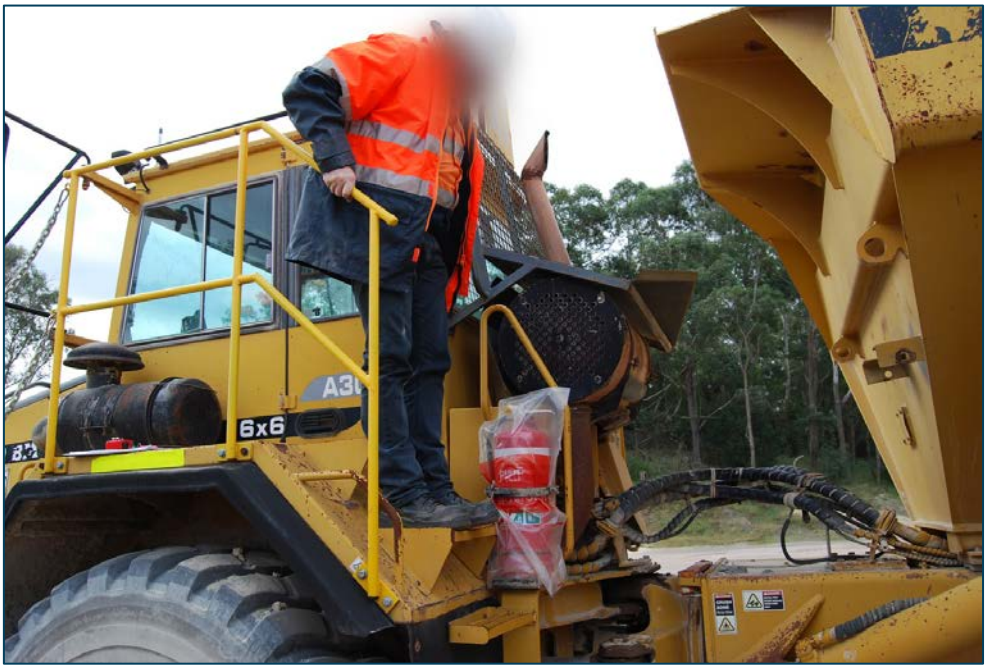
The worker exited from the cabin on the driver's side platform and opened outwards the driver side mirror.

12:56:29 pm

The worker walked down the driver side stairs in a forwards direction and then moved between the cabin and the truck tub. This was not an approved access way across the truck.

Figure 4: Simulation of a person facing rearwards and walking down the driver side stairs maintaining three points of contact using the outer edge guardrail.

The CCTV shows that the worker from a similar position on the stair then accessed the area between the cabin and the truck tub to get to the right hand side.



12:56:40 pm

The worker got onto the off-side platform.

12:56:44 pm

The worker opened the off-side mirror.

12:56:50 pm

The worker fell from the off-side platform of the dump truck.

3.5. Incident response

The operations manager ran from the driver's side of truck and attended to the worker immediately.

The first Ambulance NSW vehicle arrived at the incident scene at 1.14 pm with a second ambulance arriving three minutes later. The worker was placed into the second ambulance.

A further Ambulance NSW paramedic vehicle and third ambulance also attended.

The incident was also attended by the NSW Police.

3.6. Mobile plant (A30 number A1 dump truck)

The Volvo A30 number A1 articulated dump truck owned by Sibelco Australia Limited is a 27 tonne capacity six wheel articulated all terrain dump truck. The truck was manufactured in 1994 when the applicable access and egress standard was the fourth edition of International Standard, ISO 2867:1989 Earth-moving machinery – Access systems.

The dump truck was originally purchased by a hire company from Rutherford NSW in 1994.

The NSW supplier of Volvo trucks provided field service on the dump truck number A1 when it was at the Excelsior Quarry from 8 March 2003 to 12 October 2010.

The dump truck was acquired with other plant in January 2009 by Sibelco Australia Limited when it purchased Excelsior Quarry.

The driver's side fixed edge protection guardrail modification on the A30 dump truck number A1 was undertaken by a Sibelco engineering maintenance employee at Excelsior Quarry on 5 March 2014. There was no machine design risk assessment conducted for the hand rail modification on A30 ADT number A1.

The cost of the modification to the guardrail was approved in a work order by a Sibelco regional team engineering manager on 19 February 2014 for labour and parts totalling $2,853.

A Sibelco change management procedure dated December 2014 required risk assessment to be conducted for major plant projects involving engineering services. There was no evidence that a risk assessment had been undertaken on the upgrade of the access systems.

Figure 5: Front view of dump truck at Salt Ash site on 8 May 2016.
Showing the modified guardrail fitted only placed on the driver's side platform.

The original design of the modified guardrail for a similar dump truck at the Salt Ash site was arranged by Sibelco site management sometime before January 2014.

The Salt Ash site management had recognised a risk of operators falling while accessing the bonnet to check the engine oil and water during pre-start checks of the dump truck.

The driver's side was modified to gain safe access for daily pre-start checks; however the off-side was not accessed on a regular basis and therefore considered a lower risk.

The Australian supplier of the Volvo dump truck determined that a guardrail system would need to be specifically designed and manufactured for that type of dump truck.

Sibelco did not undertake any design risk assessment for the hand rail modification on A2 dump truck.

The A2 dump truck guardrail design was copied from photographs of newer model Volvo ADT truck. A gap was left between the guardrails to allow the wing mirror to be opened and closed.

3.6.1. Access to the off-side mirror

Opening of the bracket of the off-side (right hand) mirror from inside the driver's cabin was made difficult because of a side sliding window that only opened from the rear panel of the window frame.

The dump truck mirrors had to be operated manually; there was no automated or powered adjustment from the driver's cabin. The mirror bracket was stiff and needed a reasonable amount of direct force to partially open it. It was not possible to fully open the bracket.

There was no other mechanical means of adjustment in the truck, such as a mechanical arm extension device, to fully open and close the mirror bracket from within inside the cabin.

The low loader driver had closed the off-side mirror on the morning of 1 February 2016 from inside the cabin using the side window.

Figure 6: A person leaning outside the cabin window could not reach out to fully open the bracket from inside the cabin.

3.6.2. Off-side access features

The purpose of this access is for operation and maintenance functions. It provides access to the maintenance platform adjacent to the off-side of the driver's cab, the off-side wing mirror and a lower maintenance platform toward the front of vehicle, adjacent to the engine housing.

The off-side access consists of:

- five access steps – from the ground to top platform
- two handholds – one on either side of the access steps
- two grab rails – original equipment manufacturer supplied for window cleaning, mounted on the drivers cabin
- top platform/walkway, which is installed over the front wheel arch
- one single access step from the top platform/walkway to the lower maintenance platform
- lower maintenance platform toward the front of the vehicle – adjacent to the engine housing.

3.6.3. Review of the off-side access system

Access devices were provided on the off-side of the dump truck.

There was a vertical transition constructed on the mud guard of the truck for a person to move from the ground onto a three-tread step ladder with three points of contact provided by a left-hand hold (attached to vertical air tank) and a right-hand hold (attached to the sloping mud guard).

Figure 7: Three points of contact are possible from the ground level using the vertical hand-hold on air tank and hand-hold on the mudguard to enable access the off-side step ladder of the dump truck.

From ground level onto the step ladder it was easy to achieve three points of contact using the hand-hold attached to the air tank for the left hand and the hand hold attached to the truck mud guard for the left hand.

However, three points of contact using the left-hand vertical hand-hold on the air tank and the right-hand inclined hand-hold attached to the mudguard could not be maintained after the first step.

To access the next step the left-hand grab rail attached to the cabin rear window guard frame is available. In this location there is no right-hand side guardrail to maintain three points of contact above the first step.

Figure 8: Three points of contact for access onto the first rung of the step ladder.

To move from the upper tread of the step ladder onto the stair required the left hand to move from the hand hold on the air tank onto a near vertical grab rail attached to the rear cabin window guard frame.

The transition onto the stair from the step ladder made three points of contact difficult.

To maintain three points of contact it would require careful placement of hand and foot in the transition area above the step ladder. This was evident because there was no right hand guardrail provided higher up the ladder.

Figure 9: The hand hold and two grab rails on the truck. The vertical hand hold attached to the air tank, the near vertical grab rail attached to the cabin rear window guard frame and the horizontal grab rail attached to the top of the cabin. The photograph shows the wing mirror in a closed position. There is no guardrail on the outer edge of the upper or lower platform.

To move from the top step at position number 5 (as indicated by the yellow markers) onto the platform at position number 8 required a person to use two grab rails, both grab rails were on the same side on the cabin structure.

Using the near vertical grab rail attached to the cabin rear window guard frame would then require hand placement onto the horizontal grab rail attached to the top of the cabin roof. There was no available outer guardrail in this area to enable intuitive three points of contact.

The video recording of the worker before his fall shows he was walking towards the rear tub of the dump truck in the area of position number 8 to position number 5. The video shows his right shoulder moved towards the dump truck as if he was in the process of reaching towards either the near vertical grab rail attached to the cabin rear window guard frame or some other part of the truck.

The video also shows that the worker lost his footing at the top of the stair in the vicinity of position number 5 and fell facing forward and feet first.

The platform was degraded with an uneven and rusted surface and the slip protection tape strips were worn or missing from the platform.

The leading edge of the top step was difficult to see as it blended with the lower steps.

There was also damage to the outer flat bar welded stringer on the top step.

Figure 10: The degraded condition of the platform (position number 8) leading onto top of the steps (position number 5) visible uneven rusted surface, worn or missing slip protection tape strips on the platform.

Figure 11: A closer view of the degraded condition of platform (position number 8) leading onto top of steps.

Figure 12: The reduction in width of 160 mm of the top tread of the stair (position number 5) from the platform and the uneven, rusted surface of the platform and worn slip protection tape strip onto the top step.

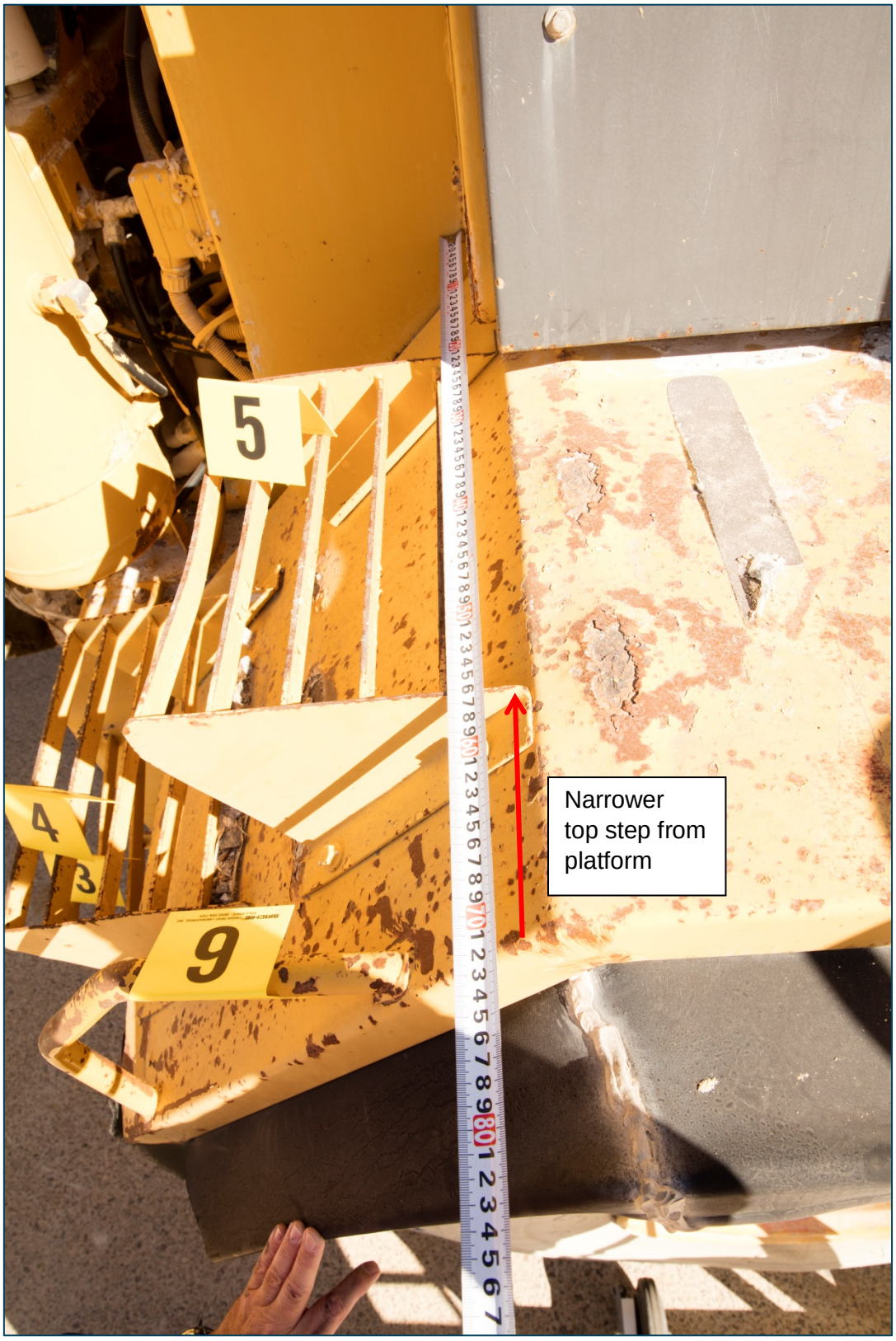


Figure 13: Difference in level from the platform to the top tread of stair.

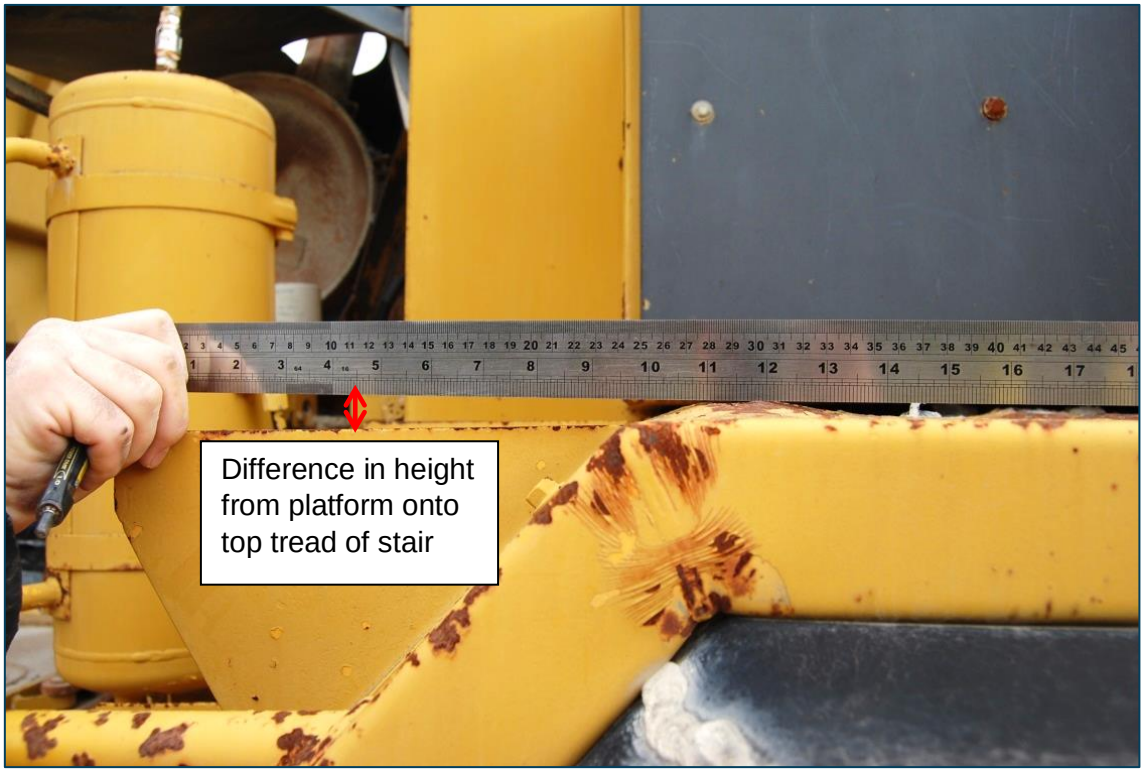


Figure 14: View from the platform of the top step tread to the lower steps. The outer edge flat bar welded stringer on the top stair tread is difficult to see.

Figure 15: The narrower and offset step ladder rungs (number 2 and 3) leading onto the stair treads (number 4 and 5) on the off- side of the dump truck.

3.6.4. Driver's side access features

The purpose of the access is for operation and maintenance functions. It provides access to the driver's cabin, the top platform/walkway adjacent to the driver's cabin, the left side wing mirror and a lower maintenance platform toward the front of vehicle, adjacent to the engine housing.

The driver's side access consists of:

- five access steps – from the ground to top platform
- handhold – on left hand side of access steps
- handrail on right hand side of access steps
- handrail and guardrail system on left hand side open edge of main and lower platform
- two grab rails – original equipment manufacturer supplied for window cleaning
- the top platform/walkway which sits over the front wheel arch
- a single step on front of wheel arch giving access to the lower maintenance platform
- lower maintenance platform
- a single step on front of wheel arch giving access to the lower maintenance platform.

3.6.5. Review of the driver's side access system

The modification undertaken on this side of the cabin gave more intuitive options for a person to maintain three points of contact when accessing the platform.

Figure 16: Three points of contact on the driver's side access step using the modified outer perimeter guardrail (left hand) and original equipment manufacturer (OEM) provided hand rail (right hand). The OEM provided hand hold on the mud guard is not intuitively used.

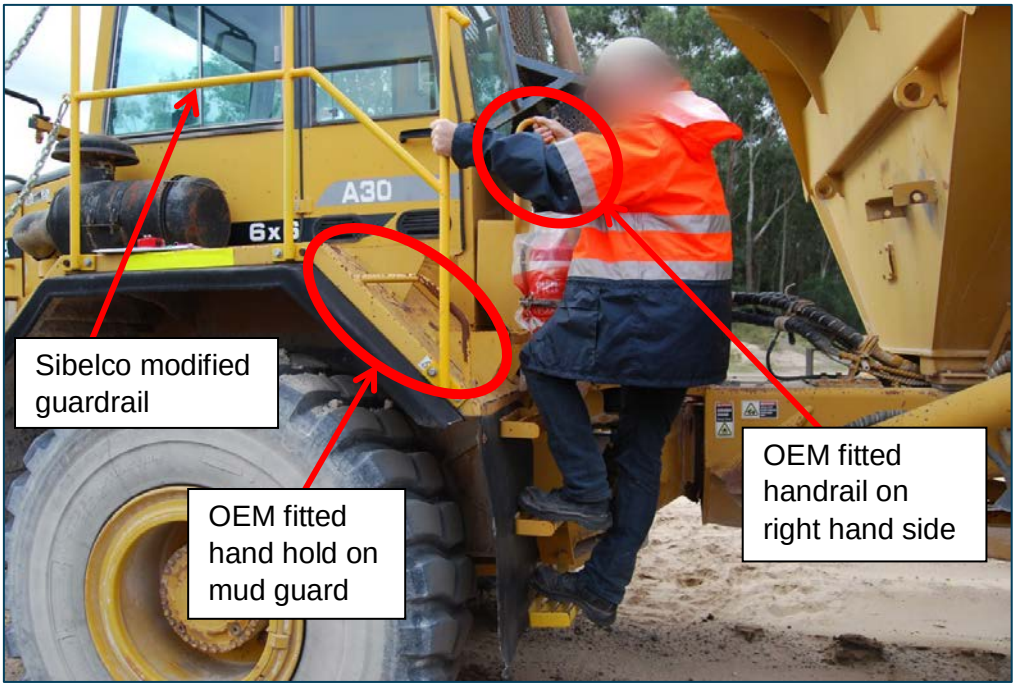
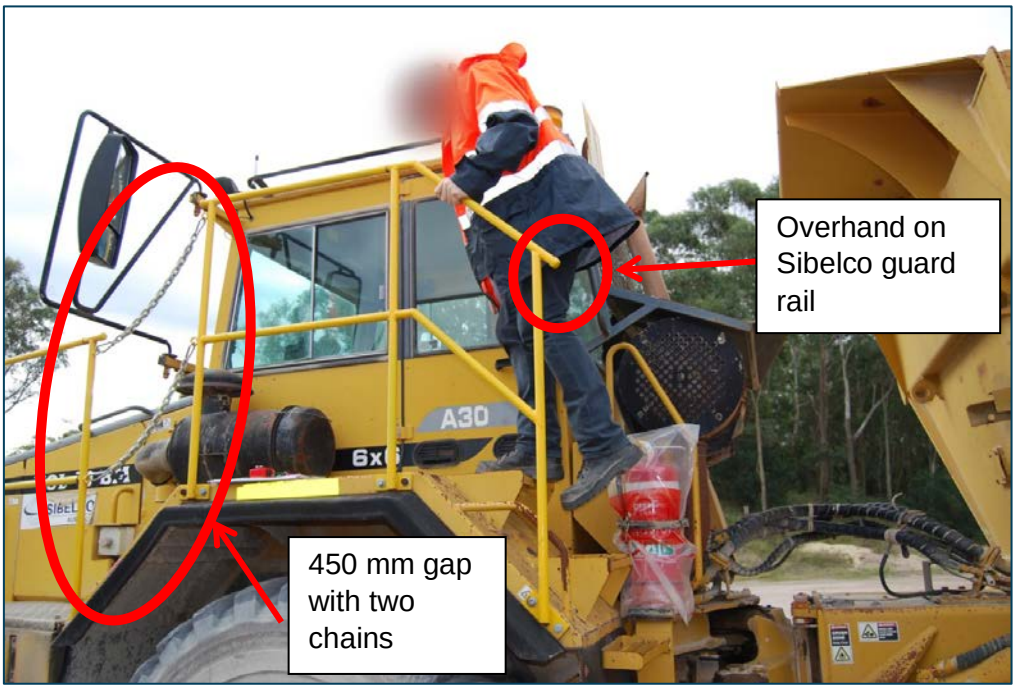


Figure 17: Three points of contact on the top step of the driver side access using the modified outer perimeter guardrail and OEM provided grab rail. A 450 mm gap with two chains is seen in the outer perimeter guardrail underneath the mirror. An overhang is present on the guardrail.



The modified guardrail had a 450 mm gap to allow the driver's side mirror to swing outwards into the operational position. A chain in a guardrail is not an effective barrier to prevent a fall. Effective three points of contact could not be maintained in the 450 mm gap section of the guardrail.

There was a short overhang at the end of the guardrail that can be a clothing catch point and did not permit continuous three points of contact with the guardrail.

While significantly better than the off-side access system, the driver's side access does not meet the industry standards of 2017.

3.7. Human and organisational factors

Human and organisational factors are the attributes that influence our behaviour at work and include three interrelated aspects of the job, the individual and the organisation. Each aspect includes characteristics known as performance shaping factors.

Performance Shaping Factors (PSF) are the characteristics of the task, the individual and the organisational factors that influence human performance. PSF operate at a number of levels within the organisation and are used to determine the key factors which contribute to the likelihood of error.[1]

In review of this incident, investigators considered it most likely that the worker miss-stepped whilst facing forwards and fell from the top of the stairway. It was considered to be an 'unintentional action' or 'error' by the worker to fall from the dump truck. The behaviour that best describes the incident is an 'action error' being a slip.

The error can be defined as 'where a simple, frequently performed physical action goes wrong'. The error can be characterised as a 'slip: where the right action is intended but the wrong action is performed'.

The review concluded that organisational performance shaping factors were significant to the causation of the incident.

Four key PSF were identified to be contributory to the incident:

- **design and modification of the plant** – the risk of falling from the dump truck had been identified
- **situational awareness and assessment** – prior training and the application of working at height risk control measures were not implemented by those performing the task
- **normalisation of the risk** – working at heights with the dump truck located on a low loader and the effectiveness of corporate safety management systems were not implemented at site level
- **risk management practices** – documented procedures were not implemented.

[1] HSE UK Human Organisational Factors

3.7.1. Falling from heights risk foreseeable

Sibelco had identified as being reasonably foreseeable the risk of fall associated with access to mobile plant before the incident.

The risk of falling from heights associated with the operation and maintenance of mobile plant had been identified in a risk assessment as early as July 2013 by Sibelco. The risk assessment was placed in the company's risk register for mobile plant operation.

A group wide EHS Alert titled 'Work at heights on Vehicles' was issued in January 2014. The EHS alert identified a fatal fall incident that occurred on 29 November 2013 when a truck driver at a non-mining site in Queensland fell 3.16 m whilst loading sugar into a truck's trailer. Sibelco identified in the alert that it had records of 46 breaches in relation to working at heights between 2010 and September 2013 at Sibelco sites and recommended several actions be taken.

Figure 18: The Sibelco EHS Alert Work at heights on vehicles dated 3 January 2014.

SIBELCO AUSTRALIA

01/14

EHS ALERT

RED
ACTION REQUIRED
Date: 03/01/2014

WORK AT HEIGHTS ON VEHICLES

Description: On November 29th a 51-year-old truck driver fell 3.16m from the top of his truck whilst loading it at the Isis Central Sugar Mill in Queensland. He sustained fatal head injuries when his head struck the ground.

IMPORTANT FACTS:

- No fall safety equipment (guarding/rails)
- No safety harness & fall arrest
- Sibelco sites are exposed to this same risk event- truck drivers are our highest risk in this area

SIBELCO AUSTRALIA WORK AT HEIGHTS DATA:

Application: All sites

Examples of safety devices to manage this risk.

Action to be taken: Develop or review JSA and SOP for drivers and mobile plant operators and maintainers to access parts of vehicles at height (incl. mobile plant). The review must include consideration of:

- Eliminating the need for someone to access high parts of a vehicle
- Safe methods of recovering from overloaded or unevenly loaded vehicles
- The need to install infrastructure to attach fall protection equipment (see picture above).
- The effectiveness of communication of working at height requirements to those at risk
- Supervision of drivers and others regarding working at heights on vehicles & mobile plant

Your HS Adviser can provide full specifications for fall protection gantry's and mobile anchor point solutions.

Confirmation of Action Taken: Operation Managers to confirm that this safety alert has been discussed with relevant site personnel and enter actions above into SAM. Please contact the EHS Administrator –

The fitting of a guardrail system on the driver side platform of Volvo A30 number A1 at the Excelsior Quarry in March 2014 further recognised the risk of falling from height on the truck.

A memorandum concerning controls for prevention of falls from vehicles was issued to operations managers on 23 June 2014. The memorandum required sites to conduct a risk assessment of the hazard of falls and to identify physical control measures for situations where a fall from a vehicle could occur.

The memorandum discussed methods of elimination of the need to work at height, such as; use of fixed or mobile platforms, and fixed and temporary guardrails or barricades to be used and fitted to the vehicle.

The memorandum also showed examples of the application of operators using mobile fall arrest systems and equipment when mobile or fixed guardrails had not or could not be fitted and the plant operator had a need to access areas beyond existing mobile or fixed guardrails.

Salt Ash site had completed a feedback form to the memorandum that identified the control measures of the memorandum were implemented.

Excelsior Quarry's feedback form to the memorandum identified the activity of Volvo A30 dump truck accessing and maintenance. Excelsior Quarry identified the risk of operators falling from equipment when performing pre-start checks at the 'go line'. Also, the 'go line' required to be sealed so that mobile platforms could be used around vehicles.

Figure 19: Extract from the Sibelco memorandum dated 23 June 2014, *Controls for prevention of falls from vehicles.* Examples of temporary or fixed guardrails or barricades fitted to mobile plant and use of mobile steps for access to mobile plant.

Figure 20: Extract from the Sibelco memorandum dated 23 June 2014, *Controls for prevention of falls from vehicles*. Shows examples of the use of mobile fall protection equipment when an operator is required to move beyond fixed or mobile guardrails on mobile plant.

3.7.2. Mobile plant access procedures

Sibelco had identified the risk of fall associated with access to and from mobile plant before the incident. All related procedures and manuals provided warnings about safe access on the dump truck.

The Volvo A30 operating manual stated:

> *'Operating instructions, a few simple rules of safety. Before operating when you are entering or leaving the machine, always face the machine and use the steps and hand holds. Always use both hands and one foot or one hand and both feet. Do not jump.'*

Salt Ash site's EHS Risk Register identified the activity of '*carrying out pre-start checks on mobile equipment'* and '*working at heights'* as hazards. The controls were listed as '*use of steps and ladders on mobile equipment, 3 points of contact.'* The additional controls were stated as '*Use of mobile platforms to assist with performing pre start checks on equipment. Cannot use mobile platforms due to lack of space and unsealed surfaces at go line'*

Sibelco's mobile plant operation and maintenance procedure dated September 2015 stated:

> *'Use three (3) points of contact when entering and exiting mobile equipment. There are potential hazards when accessing mobile equipment'*
>
> *'Dump trucks. Face the truck when mounting and maintain three point of contact with the steps and handrails at all times'*

An undated Sibelco job safety analysis (JSA) for mobile plant operation and maintenance created by the operations manager identified that '… *climbing in or out'* was a hazard and was controlled by '… *maintaining 3 point of contact on the ladder'.* It was noted that the injured worker was not included or participated in the JSA.

3.7.3. Working at heights procedures

Sibelco had working at heights procedures and permits to work at heights that were applicable to the task undertaken by the worker. The scope of the Sibelco company-wide procedure '*Working at heights'* dated February 2015 scope stated the procedure applied when:

' … a person is in or on plant or a structure that is at an elevated level or is being used to gain access to an elevated level' and a '*person is in the vicinity of an opening, edge or surface where there is a risk of a fall'.*

The procedure required hazard identification as part of a risk assessment for all work at heights to be conducted.

There was no risk assessment or JSA created for the task of unloading the dump truck that the worker undertook.

A JSA had been created for the truck loading at Excelsior Quarry on the morning before delivery to the Salt Ash site. The procedure required *'… working at height control measures will be applied to mobile plant where required'.*

The procedure also required '… *a permit to work and working at heights permit will be used for all working at heights activities above 2 metres in accordance with CWP-6.118 permit to work.'*

While on the low loader at the Salt Ash site the dump truck platform was 2.7 m from the ground.

Both the operations manager and the worker had signed onto permit to work and working at heights permits on other occasions prior to the incident.

3.7.4. Training and competency

The investigation found that the most recent training the worker had in working at heights prior to the incident was in the Sibelco company-wide procedure on 5 February 2015. He had received training in the Salt Ash standard operating procedure on 30 September 2014.

The worker held competencies from an external registered training organisation (RTO) for training in work safely at heights dated 18 November 2013. The statement of attainment issued by the RTO recommended re-training by 18 November 2014. At the date of the incident the worker had not undertaken the refresher trainer in working at heights.

The worker had undertaken a range of training programs related to risk management and operation of mobile equipment.

The worker was authorised to operate the dump truck involved in the incident.

The operations manager had undertaken external work safely at heights training on 12 March 2013.

The operations manager had authorised ‘permit to work’ and ‘working at heights permits’ on multiple occasions prior to the incident for a variety of tasks undertaken at the Salt Ash site. However on this occasion there was no working at height documentation created as the operations manager was not aware that the worker was to access the off-driver’s side of the dump truck.

4. Risk control measures

4.1. Fixed edge protection guardrail

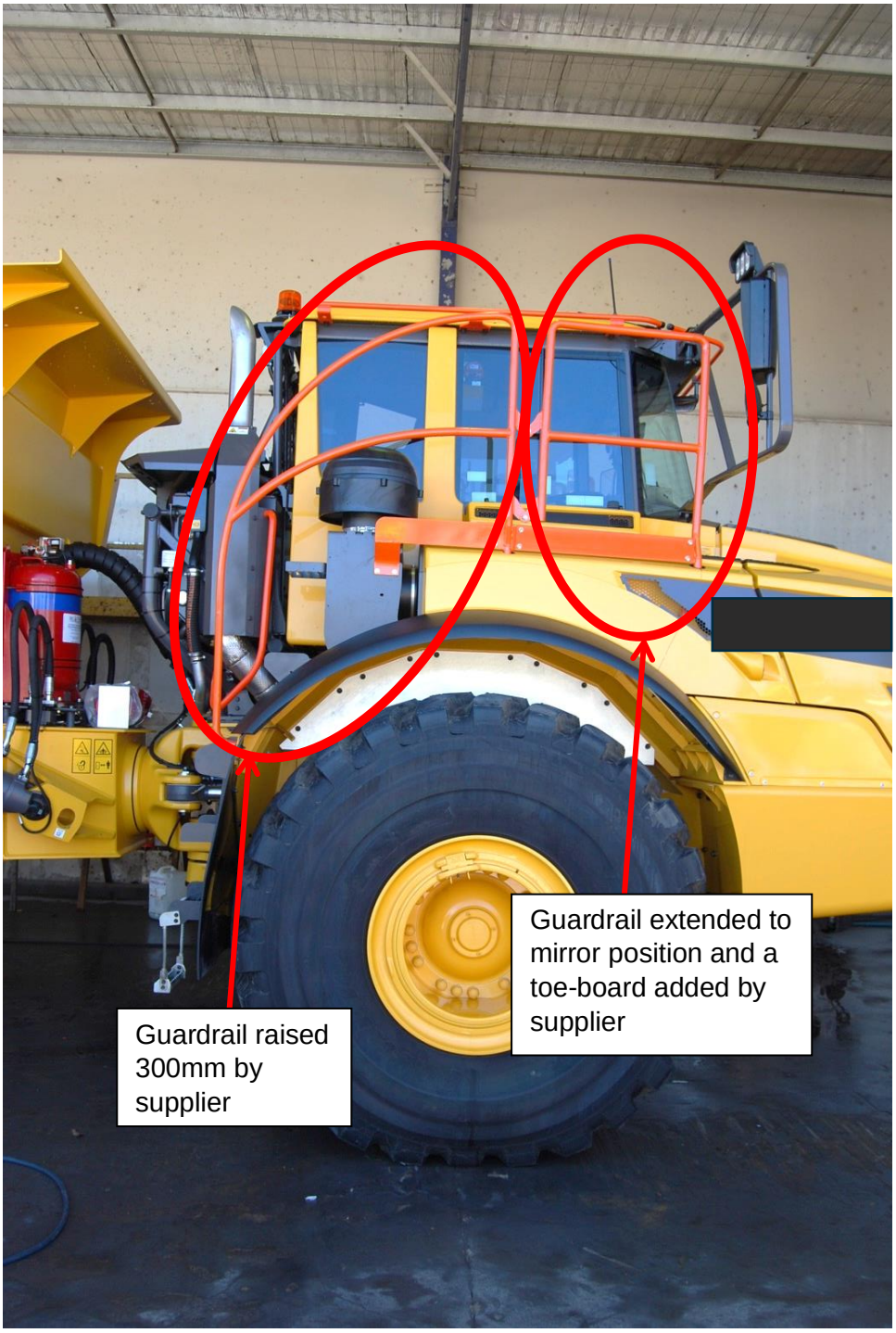
The implementation of the hierarchy of controls is a well-known and legislated tool to control risks to health and safety. The best method of control is elimination of the risk. Lower order risk controls available are engineering controls such as modification to the design of the plant.

The model Volvo A40F articulated dump truck manufactured and imported to meet ISO standards to the Australian mining industry has been modified by the Australian supplier to meet the intent of Australian Standards and published guidelines.

The Australian supplier has made further modifications to the outer edge protection guardrail by increasing handrail height by 300 mm and increasing the length of the handrail to the mirror. A toe-board has also been added to the 2017 imported model Volvo A40F dump truck.

The requirement to individually measure the incident dump truck to fit guardrails was confirmed with the Volvo Australian supplier during the investigation. The Volvo Australian supplier advised that they could design and manufacture a guardrail modification to suit the Volvo dump truck involved in the incident.

Figure 21: Australian supplier's modifications to the 2017 model off-side guardrail. Modifications include raising the guardrails by about 300 mm and extending the guardrail to the driver's mirror. Toe-boards have been fitted to the base of the guardrail.



4.2. Mobile ladder and mobile edge protection

There were alternative methods available on the day of the incident that provided safe access edge protection.

4.2.1. Mobile ladder

Two 1.5 m high mobile platform ladders rated to 150 kg were available for use at site on the day of the incident. The mobile ladders were of sufficient platform height to have been used to open outwards the off-side mirror.

The investigation found that it was possible for a person to reach the lower arm section of the off-side mirror frame with the dump truck on the low loader by using a mobile ladder on the ground level.

4.2.2. Mobile ladder and mobile edge protection

Sibelco demonstrated an example of a reasonably practicable alternative safe method of access to the dump truck platform that could have been used on 19 May 2016.

The method used a 1.5 m mobile ladder placed in line with the truck's tyre to access the platform, with edge protection provided by a metal basket (man cage) attached onto the elevated tynes of a forklift. It was noted that it was possible for the ladder to have been placed on the low loader floor in the same arrangement as demonstrated.

Figure 22: Access onto the dump truck platform using a mobile ladder and man cage.

Personal working at heights equipment was employed on the day as an additional safety measure that could be attached at various points on the cabin structure of the truck during the demonstration. However, it was noted that there were no attachment points marked on the truck that were rated as working at height attachments locations. A mobile working at heights fall arrest system would also have provided improved fall risk protection.

Figure 23: The enclosed walkway view on the off-side platform with the top of the stair in the foreground and mobile edge protection (man cage) on the forklift.

Figure 24: Person opening off-side mirror from platform with mobile edge protection.

Figure 25: Person using the handrail attached to top of the cabin with mobile outer edge protection man cage.

Figure 26: Person on the first stair tread and facing the stair looking for a right hand position to maintain three points of contact as they descend. Three points of contact is possible by first using the outer edge protection provided by the man cage and then the mobile ladder grab rail.

Figure 27: Three points of contact maintained by using the mobile ladder grab rail and vertical grab rail attached to the cabin of the truck.

Figure 28: Person descending the mobile ladder using the grab rails to maintain three points of contact.

Figure 29: Example of a mobile ladder with fixed edge protection. (Internet photo)

4.3. Fixed and mobile fall arrest systems

4.3.1. Fixed fall arrest system

It was reasonably practicable to use a fixed fall arrest system.

The device could have been used where there was no edge protection on the off-driver's side platform of the truck on a low loader. Sibelco had purchased seven fixed fall arrest systems in 2015.

Figure 30: Example of a fixed fall arrest system. (Internet photo)

4.3.2. Mobile fall arrest system

It was reasonably practicable to have used a mobile fall arrest system.

A mobile fall arrest system could have been used where there was no edge protection on the off-side platform. Sibelco had purchased two mobile fall arrest systems in 2015.

Figure 31: Two examples of mobile fall arrest systems. (Internet photos)

Figure 32: An example of a mobile fall arrest system. (Internet photo)

5. Sibelco actions post-incident

Sibelco senior management provided support services to the worker and his family and other workers at the Salt Ash site.

The Chief Executive Officer issued a company-wide communication to all Sibelco staff that addressed the risks associated with access and egress from mobile equipment. Site managers were asked to discuss these risks with their teams to ensure that all mobile plant and equipment operators were aware of the incident and the risk associated with falling from mobile plant and equipment.

The regulator's information release concerning the incident was provided to all site operations managers and senior management to further raise awareness of the incident.

The working at heights project that was underway before the incident continued to be implemented.

A behavioural training program 'Safety Starts with Me' was delivered to all employees in Sibelco Australia.

Sibelco continued its 'Going for Zero' program that included sites implementing actions for working at heights. Sibelco also continued its 'EHS' audit program with a focus on risk management and working at heights.

6. Investigation findings

6.1.1. Plant

The investigation identified the following plant issues with the dump truck:

- platform floor was in a degraded condition with an uneven and rusted walkway with slip treads missing and/or worn
- no fixed perimeter edge guardrail fall protection
- two grab rails present on the cabin body but the layout was not intuitive for a person to maintain three points of contact.
- arrangement of the steps and stairs were inadequate and were not supported by hand rails
- no physical barrier or warning sign on the off-side platform to either prevent access or provide information that a person should not proceed onto the platform without:
    - temporary edge protection barriers in place
    - and/ or use working at height fixed or mobile equipment.

6.1.2. Systems of work

The investigation identified the following Sibelco system of work issues:

- no task assessment created for the unloading task to review the risks
- documented Sibelco working at heights permit system was not used
- mobile access ladders available but they were not used for the task
- mobile edge protection systems available (fork lift with man cage) but it was not used for the task
- no mobile fall arrest system available (but these were available at other Sibelco sites)
- no fixed fall arrest system available (but these were available at other Sibelco sites).

6.1.3. People and environment

The investigation identified the following people and environment issues:

- no task assessment created for the unloading task to review the risks
- Sibelco working at heights permit system was not used
- mobile access ladders available but they were not used for the task
- mobile edge protection systems available (forklift with man cage) but it was not used for the task
- no mobile fall arrest system available (but these were available at other Sibelco sites)
- no fixed fall arrest system available (but these were available at other Sibelco sites).

6.1.4. Access risk control measures

The hierarchy of risk control measures must be considered when managing risks associated with access to mobile plant. In particular when undertaking:

- prestart inspections including window cleaning and exterior mirror adjustment
- normal production activities
- field and breakdown maintenance
- workshop maintenance
- tasks during transportation on low loaders.

Control measures were available to reduce the risk of falls from the dump truck including:

- design and installation of fit-for-purpose fixed guardrails to meet Australian Standards, codes of practice and other published guidelines
- installation of physical barriers to prevent access to platforms that did not have fixed edge protection
- display of warning signs to inform workers accessing platforms without fixed edge protection that mobile guardrails were to be used and/or mobile or fixed working at heights equipment was to be used
- the use of mobile access systems, mobile steps and mobile guardrails (including forklift and man cage) to provide temporary edge protection in areas where fixed edge protection was not provided
- the use of mobile or fixed fall arrest systems where access was required beyond the limitation of fixed or mobile edge protection systems or mobile steps.

7. Review of fall from height incidents reported to the Resources Regulator

A review of fall from heights from mobile plant incidents reported to the Resources Regulator was undertaken between 1 January 2015 and 1 July 2016.

Significant injuries are generally associated with fall from height from mobile equipment incidents.

The following relevant fall from height from mobile equipment incidents were reported:

Date	Incident	Injury
8/04/15	Surface open cut mine Worker fell from front end loader access ladder	Struck head – unconscious required brain scan
28/06/15	Underground metal mine Worker fell down steps getting out of stores truck	Lacerations to arm
15/10/15	Open cut coal mine Worker fell 2 m down emergency ladder	Lacerations to body
28/10/15	Underground metal mine Worker slipped from step of truck	Ankle fracture
6/11/15	Underground coal mine Worker fell from rear of LHD using grab handles and tow hitch as a step	Scapula fracture
27/11/15	Open cut coal mine Worker fell from work step on lighting plant	Fracture to wrist requiring steel plate
31/01/16	Quarry crushing plant Worker fell from top of a mobile screen	Broken collar bone, fractured ribs and punctured lung
1/02/16	The Salt Ash incident	Fractured skull, jaw fracture, brain hemorrhage
3/02/16	Open cut coal mine Worker fell from dozer track	Compression fractures of spine
16/02/16	Open cut mine Worker fell climbing into dozer cabin	Soft tissue injuries, hospitalised
16/03/16	Sand quarry Worker fell while exiting front end loader using rear access	Dislocated shoulder

8. Safety campaigns of industry regulators

Safe Work Australia identified there were 12 fatalities in the transport industry involving fall from height between 2008 and 2011. Falls from trucks resulted in 3100 serious injury claims.[2] Truck drivers accounted for half of the falls from truck claims. The average lost time for truck drivers after a fall was six weeks.

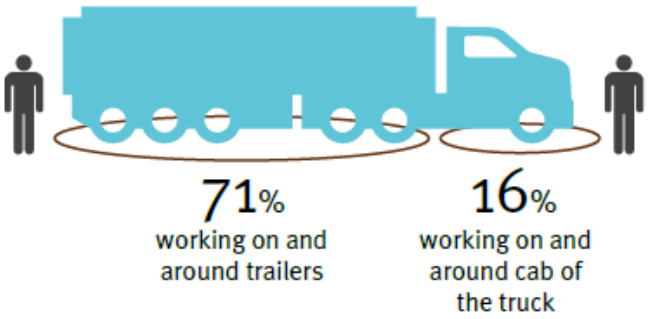
SafeWork NSW identified that there were about 160,000 workers in the NSW road freight industry and about 10 truck drivers are killed each year.[3] Fall from trucks was identified as a high risk activity and they identified that 15 workers were killed between 2003 and 2012 after falling from a truck. SafeWork NSW identified that 20% of injuries in NSW road freight transport industry are caused by falls. SafeWork NSW issued a safety alert on 5 March 2015 related to unloading flatbed trucks and trailers.

Safework QLD also introduced a safety campaign focusing on workers falling from trucks and has developed risk identification and action plans.

Safework QLD identified the risk of falls from trailers was associated with[4]:

14.4%	poorly designed ladders or steps
13%	climbing at height onto trailers to secure loads
10%	climbing onto top of trailers where there are unprotected openings
8%	ladders or steps unsafely located on trailers
8%	climbing at height up or between ramps and crates on trailers to access loads
6.5%	climbing at height onto trailers or carriers to load or unload
6.5%	jumping down from trailers
5%	using tyres as steps to climb onto trailers/walking on trailers that have become slippery with contaminants.

Safework Qld has identified the location of risk of falls from trucks:



[2] Safe Work Australia – work related injuries fatalities involving falling from height Australia

[3] SafeWork NSW safety in the road freight transport industry WC 01129

[4] Safework QLD Preventing workers falling from trucks campaign report 2015

9. Review of 2017 model truck access systems

A review by an industry consultant of four 2017 model articulated dump trucks supplied to the NSW mining industry was undertaken.

The findings of the consultant's investigation were as follows:

1. Most suppliers indicated that the 'as built' dump truck, supplied from the OEM, is what is offered to the market. However improvements to access systems are available. Typically these improvements are driven by the purchaser's requirements and the industry in which the truck will be working.

   These improvements generally deliver a better level of compliance to NSW legislation and Australian Standards, which reduces the risk of falls from the equipment. The extra cost associated with these access system improvements was seen as an impediment to sales and so was made an optional extra.

2. Access systems on the four trucks inspected, while all different, were made up of a combination of ladders, steps and platforms. This appears to have occurred due to the designer's need to match the access system components to the contour of the wheel arch. Designing the access system to be attached directly to the wheel arch and mixing access types brings with it a number of issues.

   - Complying with specific standards is difficult. The access systems do not fit any of the definitions for 'ladder', 'step-ladder', 'stairway' or 'step' and this makes it difficult to assess against the correct criteria.
   - Compromises in access system suitability and compliance are driven by the incompatibility of stairs with vertical ladders.
   - In transitioning from steps to the ladder before descending, the operator must turn to face the ladder. The size of the step makes the transition difficult. It is not designed to be used as a platform. This transition is not an intuitive action and in some cases operators may continue down the ladder facing out from the machine. If a vertical ladder is to be used it should finish at a platform, not a step.
   - The tendency to treat vertical ladders as step ladders by installing step treads instead of rungs.
   - The steps are ergonomically difficult to use, due in part to the mixing of access types which compromises the ergonomic design criteria developed by the various standards. However, the designers are also ignoring basics such as uniformity in step widths, lengths and riser heights as well as minimum step sizes that could still be achieved on a wheel arch.

3. AS 1657 is at times difficult to apply to mobile plant. Issues specific to mobile plant cannot always be solved through the application of a standard specifically designed for fixed plant.

4. During the research, issues related to the use of guidelines and standards were identified. In particular the use of references from one standard to another or from a guideline to a standard can be confusing for the reader and make it difficult to apply recommendations.

   For example the regulator's mining design guideline MDG 15 Mobile and transportable equipment, 3.1 Access Systems, 3.1.1 General, states:

   > *Spacing and design of steps, ladders and walkways shall be in accordance with AS 1657 and AS 3868 as a minimum but should in addition conform to the following:-*

a) Australian Standard AS 3868 shall be used where the height of the required access platform is 2 metres or less from ground level, and

b) Australian Standard AS 1657 shall be used where the height of the required access platform exceeds 2 metres from ground level.

5. To apply AS 3868, the user is required to apply parts of AS 1657 for stairways and rung ladders and there is no reference to height above the ground in either of these standards.

   Confusion can occur due to contradictions between AS 3868, AS 1657 and MDG15.

6. Confusion can occur due to contradictions between AS 3868, AS 1657, MDG15 and the relevant ISO standards ISO 2867 and ISO 14122.1, 2, 3, 4.

7. ISO 2867 identifies vertical ladders as the preferred solution to a situation where safer low angle stairways and walkways are not possible. It chooses this solution over the use of lower angle step-ladders , (even though the physical effort required to use a vertical ladder is greater), because of the way ladders are used:

   - It is safer to descend from a ladder because the user always faces inwards.
   - The user has to hold on with both hands while ascending and descending.

   However, as most of the access system steps are 'as supplied from manufacturer' it would appear that these safety considerations in ISO 2867 have not been applied.

8. AS 3868 and AS 1657, both identify vertical ladders as a style to avoid if possible. However, as most ADT access systems from the ground to a platform are vertical (or close to it), a properly designed vertical fixed ladder may be a better solution.

9. The management of the risks of falls from height in NSW applies to all workplaces. With respect to falls from dump trucks, a significant difference exists in expectations with regard to access system design and compliance, between the mining and civil construction industries.

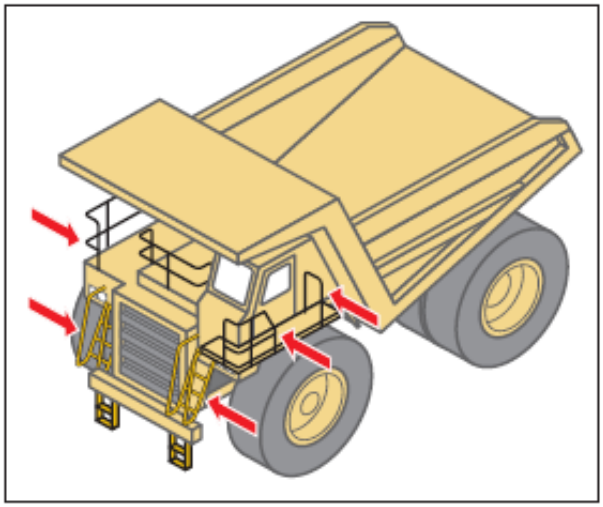
10. In general, robust 'Introduction to Site' schemes exist across coal and metalliferous mines in NSW. These schemes have been developed around the requirements of MDG15 and the associated Australian Standards as part of site *Mechanical engineering control plans* and *Electrical engineering control plans* (MECPs and EECPs). This has driven an improved approach to dump truck access systems and the management of falls from heights on mobile plant in general.

    The same cannot be said for civil construction. It appears a lack of understanding of the requirements to manage the risk of falls and a cost driven focus on equipment purchase and introduction to site may be the cause of the lack of compliance

11. The example given in the SafeWork NSW code of practice Managing the risk of falls at workplaces (July 2015) requires the consideration of further controls to meet best practice for mobile equipment. Figure 34 of the SafeWork NSW document shows a haul truck. It should be noted:

- a number of platform edges are not protected with guardrails
- vertical ladders are used, where stairs can be used
- gates are not installed at the edge of access/egress points on guardrails.

Figure 34
Dump trucks.



12. The version of MDG15 used in this report is the March 2002 edition. This is the latest version. An updated version of MDG15 was issued as a draft in 2015. The final version is yet to be released.
13. Review of four existing model dump truck available to the NSW mining industry took place. It was identified that some imported trucks have modified access systems to meet the intent of Australian Standards and MDG15. Some other imported trucks are being sold into the construction industry without any access modifications and are generally designed to meet ISO standards.

Figure 33: An imported dump truck with Australian modified access systems.

Figure 34: Imported model dump truck without access systems modification.

Figure 35: Dump truck with Australian modified access systems.

Figure 36: Imported model dump truck without access systems modifications.

10. Published recommendations

Industry recommendations published April 2016

Recommendations to the mining industry were published in the Resources Regulator's investigation information release, IIR16-03 Worker seriously injured in fall from articulated dump truck on 21 April 2016.

Industry recommendations published December 2016

The Resources Regulator published a safety bulletin, SB16-06 Injuries incurred from falling plant on 22 December 2016.