

Level Two Investigation

Region 3 Area 16 Mercedes Bronto Skylift F32RLX
Event Type: Cage Levelling System Failure
Event Date: 19 June 2017



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Executive Summary

Event Details

On Monday 19 June 2017, whilst carrying out the Weekly Checks on the Mercedes Bronto Skylift F32RLX (FEY 849/ Newtown 225)[Fig 1] at Newtown Fire Station, the crew experienced a catastrophic failure of the cage levelling system.

The Bronto was immediately booked out of service and the Brigade Mechanical Service Provider (Lockheed Martin) notified. They responded to Newtown Station within an hour, bled down the hydraulics to house the Bronto and it was taken to their workshops at Trentham for assessment. [Refer Fig 4]

The Region Fleet Manager and the Head Mechanic tried to recreate the fault and failed to do so.

Due to the potential for serious harm the Area Commander requested a Level Two Investigation be instigated.

On Friday 21 July the Level 2 Investigation Team requested a recreation of the event and assembled at Lockheed Martin. The original OIC was available and performed similar movements resulting in the same fault occurring but not as violently. [Fig 2&3] also [Fig 5]

The NZ Bronto service agents – Access Specialties from Auckland, attended on 25 July and effected adjustments to the Cage Tilt minimum bias and stated “it was over-correcting due to normal wear and tear over time” and the Cage Down function which was “set too fast”. They also noted play in the Cage Slew Sensor shaft connection.

Key Findings

- The fault appears to be due to mechanical breakdown caused by wear and tear. It has been impossible to tell if this is due to maintenance issues as there has been no answer to the L2 Investigation Teams request for Bronto to provide
 1. A programme of preventative maintenance for this model (F32RLX).
 2. A list of other brigades worldwide that have this model so as to check if they too have had these issues.
- Fleet invoicing provided only brief descriptions of work carried out and this information is only visible to Fleet and the service provider.
- The Level 2 Investigation Team noted it took 5 weeks for Access Specialties to be brought to Wellington to assess the fault.
- Remote Dial-in access from Bronto Finland was *not* available for Newtown 225 (FEY849) due to an unknown sim-card issue.
- The L2 Investigation Team finds that Lockheed Martin, whilst not authorized or trained Bronto technicians, try their best to rectify faults using knowledge gained from working on the trucks for some years. This however is often a trial and error approach coupled with anecdotal information supplied by the authorized service agents.
- There is a long history of faults and safety concerns with this appliance (FEY 849), which has created significant trust and confidence issues within the crews that operate it. This is compounded by “reporting fatigue” from crews who continually list faults that keep reappearing. There is evidence of this fault, or similar, being reported 5 times since 9 September 2014, it appears to have been fully investigated only once at Lockheed Martin and no repair effected until this failure.

Reporting problems are endemic. The crews do not always report faults correctly and there is no reporting of rectification of faults back to crews when the appliance returns to service. There is an apparent breakdown in communication between the groups in the process who tend to operate in silos. Namely – Station, Area, Fleet, Local Service Providers and Bronto Approved Agents.

Executive Summary continued

- The Safety, Health & Wellbeing Coordinator found out about the incident informally a week after the event and immediately promulgated a Safety Alert in consultation with the Area Commander. This should have been an automatic notification at the time the seriousness of the incident was realized.

- The L2 Investigation Team has discovered inconsistencies in Type 5 & 6 Aerial training nationwide relating to many aspects in the operation of these appliances – this needs to be addressed as the Wellington crews are not taught crucial emergency make-up details.
- The aerial policy FL4POP is not being followed due to the difficulty in having spare appliances available around the country.
- The AFAC Aerial Code of Practice Guide (FL4 GD) is not being followed – Section 1.6 Aerial Appliance Maintenance states in 1.6.3 “In scheduling maintenance of the aerial apparatus, consideration is to be given to related components on the whole appliance. Maintenance shall be performed by a competent person and a concise and accurate maintenance history shall be kept for the appliance”

Main Conclusions

This fault could have been rectified much earlier had the NZ Bronto service agents, (Access Specialties from Auckland) been brought in at the outset. The local fleet service provider does not have the expertise or computer tools to assess the aerial component faults. The Bronto’s computer SIM Card was found to be faulty, this complicated and compounded the delay.

- This fault was first reported in 2014 and never addressed with Access Specialties until the latest catastrophic failure. Access Specialties should be consulted for all aerial component faults and at the service providers discretion when the SIM Card does not function and remote dial-in is not possible.
- The current fault recording and reporting system is ineffective and ambiguous. There is inconsistent and fractured communications between operational crews, fleet coordinator and management leading to assumptions around repairs found and completed. The system needs redesigned with a comprehensive fault report and repair log kept with each vehicle. Zendesk reporting could be utilised to keep all parties informed at each step in the process.
- FENZ large aerials (Type 5’s and 6’s) can be high-use machines due to the long hours of training they are utilised for. This highlights the fatigue and wear that on-shift training places on these vehicles. This contributes to possible higher maintenance issues, particularly as they age. The previous points are exacerbated by the obvious lack of suitable replacement aerial cover nationwide in New Zealand.
- The Type 5 & 6 aerial training package needs to be standardised throughout the country. There are clear inconsistencies nationwide around training. For example, Wellington operators are shown only two back-up techniques to operate the aerial (Electric over Hydraulic and HATZ APU), whereas in other parts of the country operators also learn hydraulic bleed-down techniques. This is important as it is a further means of lowering the aerial for crew safety or swinging it away from a burning or collapsing building.
- A member of the fleet team had reported an incorrect conclusion (operator error) regarding the cause of this event prior to being presented with the facts and evidence which proved otherwise. This was not well received by the crews and appears to be a flippant and unhelpful remark.
- Non-operational operators (fleet team, service providers etc.) appear to have not undergone approved operator training. This exposes the organisation if an accident were to occur whilst one of these people were operating these aerials.

Terms of Reference

Sponsor

Bruce Stubbs

Area Commander - Area 16 Wellington

Team Leader

Des Hosie

Safety Health & Wellbeing Advisor

Region 3 Wellington

Investigation Team Members

Senior Station Officer Chris Lind – Region 1 Auckland

Senior Station Officer Mark Leonard (NZPFU Rep) – Region 5 Dunedin

Terms of Reference

- Describe the facts leading up to, and relating to the event
- Identify underlying factors that may have contributed to the event
- Identify any new or significant hazards that may have contributed to this event
- Identify all relevant Operational Instructions and FENZ Policies and determine whether they have been followed and were effective
- Identify items for consideration as recommendations as a result of this investigation, or for inclusion in a Corrective Action Plan

Event Description

On Monday 19 June 2017, whilst carrying out the Weekly Checks on the Mercedes Bronto Skylift F32RLX (FEY 849/ Newtown 225) at Newtown Fire Station, the crew experienced a catastrophic failure of the cage leveling system.[refer Fig 4]

The Bronto was being operated from the Pulpit Control Position by the OIC of the crew. There was no one in the cage at the time the incident occurred. The OIC had been told at hand-over that there had been some issues regarding getting the Bronto into the housed position during the previous shift. Due to his experience with the appliance's known quirks he decided to start the checks without an operator in the cage for safety reasons. He sent the driver to the station store to retrieve the AdBlue additive for the diesel fuel tank of the appliance as they were to refuel after the checks were completed. This proved to be a sound decision and risk assessment as shown by the ensuing incident.

The OIC couldn't raise the Bronto from its cradle without engaging the Multi (manual override) Button due to the cage slew being slightly off centre. He began rotating and elevating/extending as it moved in a right hand direction. When the Bronto achieved approximately 180 degrees rotation and 45 degrees elevation the boom stopped suddenly, it shook violently and the cage dropped forward. Such was the reaction the OIC stated "had someone been in the cage they would have been ejected".

The OIC tried to re-house the aerial but the controls were frozen. He attempted the emergency re-house procedures utilizing the Electric over Hydraulic Motor and the HATZ Motor. Both of these were inoperable.

The Bronto was immediately booked out of service and the Brigade Mechanical Service Provider (Lockheed Martin) notified. They responded to Newtown Station within an hour, bled down the hydraulics to house the Bronto and it was taken to their workshops at Trentham for assessment.

The Region Fleet Coordinator attended and he and the Head Mechanic from Lockheed Martin tried to recreate the fault and failed to do so.

The Fleet Coordinator reported to the On-Call Assistant Area Commander that the fault couldn't be recreated.

Due to the potential for serious harm the Area Commander requested a Level 2 Investigation be instigated.

On Friday 21 July the Level 2 Investigation Team requested a recreation of the event and assembled at Lockheed Martin. The original OIC was available and performed similar movements resulting in the same fault occurring but not as violently. The Fleet Coordinator then attended and the fault recreated a second time for his benefit. There were several unusual computer fault readings that could not be interpreted by the group in attendance. The cage angle was showing -23.5deg when the normal reading should maintain at 0deg (but with a minor tolerance either side of 0deg) [Refer Fig 5]

The NZ Bronto service agents – Access Specialties from Auckland, attended on 25 July and effected adjustments to the cage tilt minimum bias and stated “ it was over-correcting due to normal wear and tear over time” and the Cage Down function which was “set too fast”. They also noted play in the Cage Slew sensor shaft connection.

Gathering Evidence

The Level 2 Investigation Team (The Team) used the Incident Cause Analysis Method (ICAM) Advanced Investigation Techniques model to investigate this incident.

Once assembled, the Team visited the site to get a visual perspective of the area the incident took place and the surrounding environment.

The Level 2 Investigation Team used the ICAM Root Cause Investigation Methodology to:

- Plan the approach
- Gather all of the information available as evidence, including photographic evidence and witness statements
- Establish the sequence of events using the time ordered-events chart
- Analyse the evidence using James Reason's “Swiss Cheese” model (Reason, 2004)
- Consider issues from findings to be considered as corrective actions to improve processes and procedures in the future

The Level 2 Investigation Team

- Has conducted interviews with the on duty crew involved in the initial incident and visited the site where the incident took place at Newtown Fire Station. The Team interviewed the Fleet Manager, Area Commander, Lockheed Martin's Head Mechanic and spoke to various operational crews who work with this appliance regularly.

- Visited Lockheed Martin Workshops at Trentham and inspected the vehicle fault book on FEY 849. The Team also viewed the maintenance file kept by Lockheed Martin for this appliance. It contained only the records of the truck's "A", "B", "C" Services and COF's along with a 6 monthly hydraulic test. There was no records available pertaining to the aerial component of the appliance.
- Participated in a recreation of the fault event which included the OIC who was the operator when the event happened. The local brigade aerial trainer, the Fleet Coordinator, the Head Mechanic from Lockheed Martin were also present and witnessed the recreated events.

Policies, Procedures and other related documents were reviewed and assessed in relation to the Terms of Reference.

- The AFAC Aerial Code of Practice Guide (FL4 GD) – Section 1.6 Aerial Appliance Maintenance states in 1.6.3 "In scheduling maintenance of the aerial apparatus, consideration is to be given to related components on the whole appliance. Maintenance shall be performed by a competent person and a concise and accurate maintenance history shall be kept for the appliance". The AFAC Guide also states an aerial's cage levelling system should be checked quarterly by a competent person.
- FL4 GD Section 2.5.1 states "Fire Services are required to provide a fully controlled reporting system which includes all fault identification, rectification and testing/inspection details"
- FL4 POP is the aerial appliances policy of FENZ. It makes reference to support documents that do not exist anymore or have been renamed. This policy needs reviewed and updated.
- On-station vehicle and equipment check sheets were reviewed. Inconsistencies' in reporting were found but were not serious breaches.

Findings

Finding 1

The current fault recording and reporting system is ineffective and ambiguous. There is inconsistent and fractured communications between operational crews, fleet coordinator and management leading to assumptions around repairs found and completed.

Finding 2

FENZ large aerials (Type 5's and 6's) can be high-use machines due to the long hours of training they are utilised for. This highlights the fatigue and wear that on-shift training places on these vehicles. This possibly contributes to higher maintenance issues, particularly as they age.

Finding 3

Reporting problems are endemic. The crews do not always report faults correctly and there is no reporting of rectification of faults back to crews when the appliance returns to service. This is made worse by the apparent breakdown in communication between the groups in the process who tend to operate in silos. Namely – Station, Area, Fleet, Local Service Providers and Bronto Approved Agents.

Finding 4

The aerial fleet nationally is deficient. There is a severe lack of spare aerials nationwide which places significant pressure on all levels of the organisation from fleet to operations to deliver the best service possible with the minimum resourcing. The "tiered approach" is not working. There is difficulty in providing adequate aerial relief appliances due to geographical location and the differing types of these appliances. For Wellington to get a spare aerial the Spartan from Hamilton has to go to Auckland and the Parnell RLH has to then com to Wellington as the Wellington operators aren't trained on the Spartan.

Finding 5

The Level 2 Investigation Team finds that Lockheed Martin try their best to rectify faults using knowledge gained from working on the trucks for some years. This however is often a trial and error approach coupled with anecdotal information supplied by the authorized service agents and does not comply with FENZ Policy FL4 GD.

Finding 6

Aerial policy and procedure FL4 is in urgent need of review. It is not current and creates confusion with missing or re-named documents with no forward referencing.

Finding 7

There is no national forum for collating information about repairs, maintenance, breakdowns or learnings pertaining to the national aerial fleet. If Wellington has an issue with one of their Brontos' the learnings should be available to all other type 5 & 6 users for future research in case of similar issues occurring elsewhere. The Zendesk reporting system could be helpful here also.

Recommended Corrective Actions

Finding 1 RCA

A simple service/maintenance/repair log book should be available in all aerial appliances.

This should list in some detail all work carried out on both the vehicle and aerial component. With this crews can reference a fault and immediately identify it's status, whether rectified or not. This will also assist any future accident investigations. This should be set up to include all aspects, including what is checked/considered/assessed during routine maintenance particularly on the aerial component. It was unclear to the Level 2 Investigation Team through searching vehicle records whether standard maintenance as per the Bronto service schedule is followed, including the replacement of parts on a time based schedule as opposed to when they defect.

Finding 2 RCA

The Team recommends the consideration of Black Watch courses for delivery of aerial training, particularly for Type 5 and 6 vehicles. This will significantly reduce the possible wear and tear imposed on these expensive assets, and extend their operational longevity.

This also introduces a degree of consistency in training delivery across all staff. This training should also be transferred nationwide so all operators are taught the same techniques.

The investigation team also recommend the attendance of these Black Watch courses for both service providers and national fleet members who are expected to operate these vehicles from time to time.

Again this provides consistency in operation, but also provides risk management in terms of training users in line with the *Health and Safety at Work Act 2015*.

Finding 3 RCA

The Team identified a number of organisational silos without links, or where the information links are very fragile. This involved fleet, local service providers, approved agents, safety and wellbeing, area management and operations.

To overcome this a streamlined process needs to be created throughout these layers to ensure all parties have full access to the relevant information. Utilising the Zendesk reporting system could be an option for this.

Finding 4 RCA

The Team believe the national aerial strategy needs urgent review to address this. Re-tasking The type 5 aerial fleet in Auckland and Wellington could be a possible solution. Newtown's F32 RLX could transfer to Auckland to compliment the Type 6 RLX and Parnell's F32 RLH could transfer to Wellington to compliment Thorndon's RLH. That would give both cities aerials of the same type thereby negating the need for each cities operators to train on two different types of aerial.

Finding 5 RCA

The Team agree that all identified faults/issues with all aerial appliances need to be investigated by an approved Bronto agent either directly or remotely via the cellular link, if available. The expectation would be that all work is carried out to the manufacturers recommendations and standard. The Service Level Agreement between FENZ, Access Specialties and Lockheed Martin needs to be reviewed to confirm the training level of sub-contractors.

Finding 6 RCA

Aerial policy FL 4 should be urgently reviewed and updated.

Finding 7 RCA

Set up a Dropbox file or similar as a National Aerial Forum with access available to all Areas with aerial appliances. Each aerial appliance can have its own file so maintenance issues or learnings can be recorded and available to all other users as a reference. Utilising the Zendesk reporting system could be an option for this also.

Report Approvals

Investigation and report completed by:

Investigator

Name: Des Hosie

Job Title: Region 3 Safety, Health & Wellbeing Advisor (Acting)

Date:

Everything in this statement is true to the best of my knowledge and belief, and I made the statement knowing that it might be admitted as evidence for the purposes of the standard committal or at a committal hearing and that I could be prosecuted for perjury if the statement is known by me to be false and is intended by me to mislead.

This report has been approved by:

Sponsor

Name: Bruce Stubbs

Job Title: Area Commander (Area 16 Wellington)

Date:

and complies with the Fire and Emergency New Zealand Official Information Policy (POLCM.2.)

Supporting Photographs

(Fig 1) Bronto Skylift F32 RLX Newtown 225



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(Fig 2) Lockheed Martin Workshops 21/7/17 Cage Tilt Fault Replicated



(Fig 3) Lockheed Martin Workshops 21/7/17 Cage Tilt Fault Replicated

(Fig 4) Newtown Station 19/6/17 – Partially lowered by Mechanic having bled down hydraulics





(Fig 5) Lockheed Martin Workshops 21/7/17 – Bronto computer showing Cage Angle of -23.5deg



