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Bus Safety Investigation Report

Bus Fire MO9994 — Green Valley, 8 August 2022

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Bus Safety Investigation Report

Bus Fire MO9994

Green Valley, NSW

8 August 2022

Cover image: Transit Systems

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Executive summary

On the evening of 8 August 2022, bus MO9994, operated by Transit Systems NSW, was conducting a scheduled passenger service on route 805 from Liverpool to Cabramatta, NSW. As the bus approached The Valley Plaza shopping centre, Green Valley, the driver smelt smoke inside the bus. The driver stopped the bus at The Valley Plaza bus stand and observed smoke above the front door. At that time, one passenger disembarked, and three passengers remained seated in the bus.

While waiting for a return radio call on a private channel, the driver exited the bus to look around the exterior for the source of the smoke. The driver observed what they later described as 'sparkling' in the overhead panel above the driver's seat. After contacting the company's depot via phone and observing flames coming from the overhead panel, the driver re-entered the bus and safely evacuated the three passengers without incident.

Shortly after the evacuation, flames rapidly spread from the overhead console, engulfing the vehicle. Fire and Rescue NSW attended and extinguished the fire. The bus was destroyed.

The investigation identified that an electrical fault within the Accessory Panel, located above the driver's position, likely generated heat which ignited surrounding combustible material, resulting in an intense fire. The Accessory Panel electrical circuit on the involved bus, and two exemplar buses inspected as part of the investigation, were not adequately protected from over current faults, such as a short circuit. The fuse protecting the circuit exceeded the ampacity of the associated cables.

In addition, the electrical circuit isolation design and configuration of the involved bus, and two exemplar buses, did not allow isolation of the Accessory Panel circuit, resulting in no protection from ongoing provision of energy for the escalation and propagation of fire from a short circuit. This configuration did not comply with the Transport for NSW (TfNSW) Bus Procurement Panel specifications under which these assets were procured. At the time of the incident, the isolation system's limitations had not been identified by the bus chassis or body builder, Original Equipment Manufacturers, TfNSW, or the bus operator.

The investigation identified safety improvement opportunities including the review of bus operator emergency procedures and provision of practical, competency-based driver refresher training for safe and effective management of emergency situations.

Ten Recommendations resulted from the investigation. Operators should review maintenance regimes to ensure inspections adequately address and remedy any issues with wiring integrity and security, including protection of live terminal posts and proximity to other conductive materials. It was also recommended that TfNSW develops and implements an inspection and rectification program, to ensure electrical circuits on the current fleet of buses operating contracted passenger services are adequately protected and can be effectively isolated as required.

In addition, the Office of Transport Safety Investigations (OTSI) recommends that TfNSW reviews current asset management requirements, to apply a more comprehensive safety risk management and regulatory framework for long-term asset management.

Full details of the Findings and Recommendations of this bus safety investigation are contained in Parts 3 and 4 respectively.

Part 1 — Factual information

Events leading up to the occurrence

1.1 At approximately 1745[1] on 8 August 2022, bus MO9994 departed Liverpool train station on scheduled passenger service route 805, bound for Cabramatta. This was the third scheduled service of the day undertaken by the involved bus and driver since the start of the driver's shift at 1203.

1.2 The bus travelled without incident on the route, as per the designated timetable, until reaching the vicinity of The Valley Plaza shopping centre, Green Valley. The driver later recalled that it was dark by that time.

1.3 At approximately 1812, MO9994 entered The Valley Plaza with four passengers on board. The driver noted that the next stop request signal was illuminated and prepared to stop the bus at The Valley Plaza bus stop. At around this time, the driver recalled that they smelt smoke inside the bus and thought a passenger in the back was smoking.

The occurrence

1.4 Shortly after, at approximately 1813, the driver pulled the bus into the shopping centre bus stop and opened both doors, with one passenger disembarking.

1.5 With both passenger doors open, the driver's cabin and front entrance area were illuminated by a light located above the ticket console of the driver's cabin. The driver noticed smoke covering the ceiling area above their head and observed thick, dark smoke above the front door opening and coming out of an air vent located above the door.

1.6 The driver applied the park brake and turned off the ignition. At that time, three passengers remained seated in the bus.

1.7 At interview, the driver reported that they did not activate the emergency electrical isolation switch for the bus, located to the right of the driver's position, as they thought it would turn off the radio.

1.8 The driver called the company control centre on an open radio channel to report smoke in the bus. The driver later recalled that the controller instructed them to hang up as they would receive a call back on a private radio channel. While waiting for that radio call, the driver exited the bus through the front doors to look around the exterior for the source of the smoke.

1.9 At approximately 1814, while investigating the bus exterior, the driver, who was standing near the open front doors, looked into the bus and observed what they later described as 'sparkling' near the radio above the driver's seat (Figure 1). The driver commenced recording the smoke using the video function of their personal mobile phone.

[1] Times in this report are in 24-hour clock form in Australian Eastern Standard Time.

Figure 1: Illumination in the overhead console observed by the driver

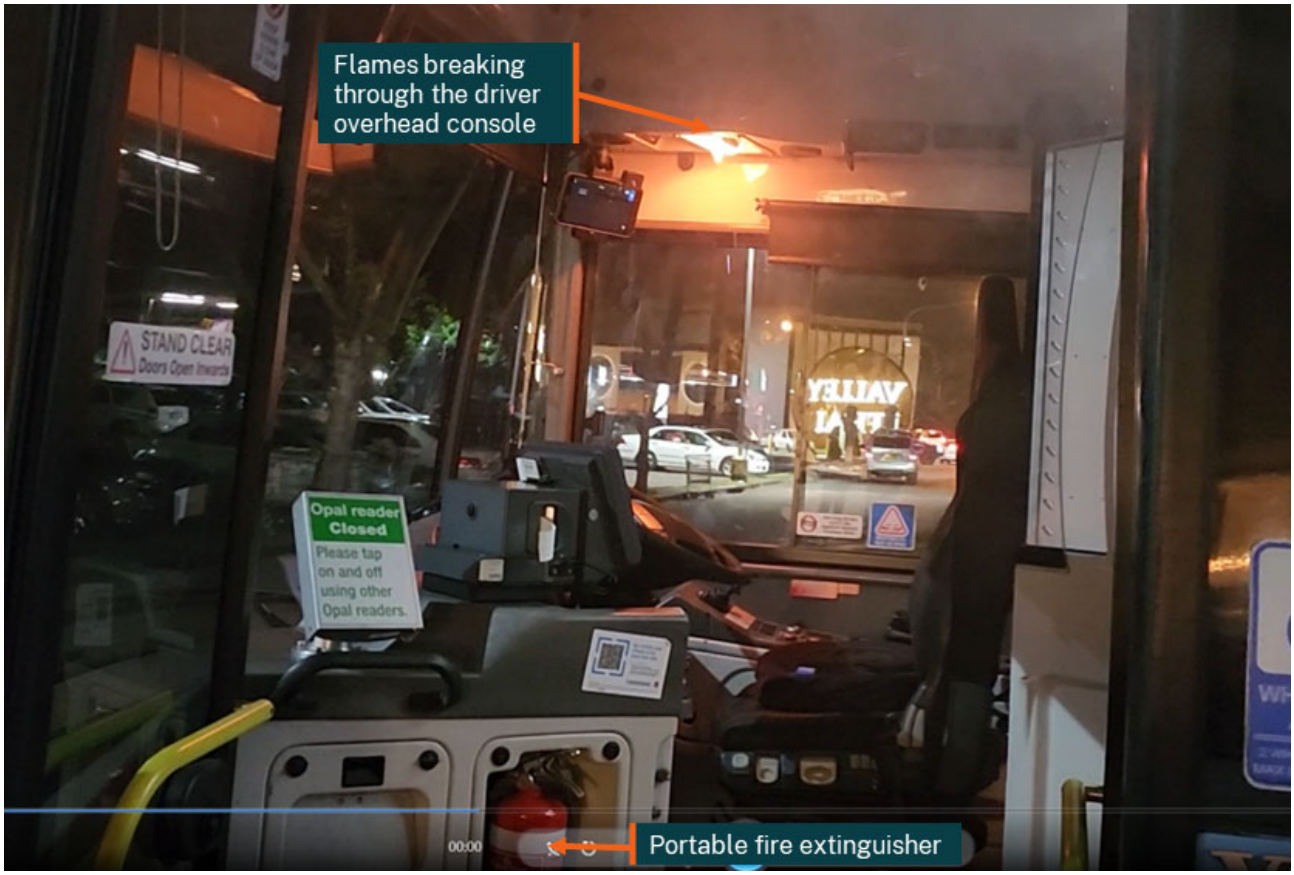
Source: Transit Systems NSW, annotated by OTSI. Video time stamp 1814:30

1.10 The driver, concerned about what they observed, called the company control centre on their mobile phone. As the driver spoke to the radio room, they noticed the 'sparkling' turn to flames. The company controller informed the driver to hang up as they would call emergency services.

1.11 The driver entered the bus and instructed the remaining three passengers to disembark. The driver retrieved their own belongings from the driver's position and exited.

1.12 While waiting for emergency services, the driver observed flames intensify in the console above the driver's seat (Figure 2). The driver did not discharge the onboard fire extinguisher.

Figure 2: Flames breaking through the overhead console panel



Source: Transit Systems NSW, annotated by OTSI. Video timestamp 1815:17

1.13 By 1819, the salon of the bus was filled with black smoke and flames, which spread to the ceiling inside the forward section. Shortly after, the flames spread to the bus exterior, through the forward passenger windows and front door. The fire engulfed the bus before Fire and Rescue NSW arrived (Figure 3, Figure 4).

Figure 3: Escalation of fire

Source: Transit Systems NSW, annotated by OTSI. Video time stamp 1822:02

Figure 4: MO9994 engulfed in flames when fire hose first deployed

Source: Transit Systems NSW, annotated by OTSI

1.14 Fire and Rescue NSW extinguished the fire. The bus was destroyed.

Incident location

1.15 The incident occurred at the bus stop in The Valley Plaza, in Green Valley, approximately 39 km west of the Sydney Central Business District, in the state of NSW (Figure 5, Figure 6).

Figure 5: Incident suburb location

Source: Six Maps, annotated by OTSI

Figure 6: Incident site location in The Valley Plaza

Source: Six Maps, annotated by OTSI

Environmental conditions

1.16 According to the Bureau of Meteorology, on the evening of 8 August 2022 there was a southerly wind. A temperature of 16.1°C was recorded at 1500 at the Sydney Observatory Hill weather station, about 32 km west-south-west of the incident.

1.17 On the day of the incident, sunset was recorded at 1731:34, and the end of twilight at 1746:18.

1.18 The investigation determined that environmental conditions were not a contributory factor to this incident.

Bus operator information

1.19 At the time of the incident, MO9994 was operated by Transit Systems NSW Pty Ltd (TSNSW). TSNSW operated and maintained a fleet of buses owned by Transport for NSW (TfNSW), under contract as an accredited operator.[2]

1.20 TSNSW operated Contract Region Three in the Sydney metropolitan area. Region 3 (Parramatta, Fairfield & Liverpool) was operated by Transit Systems South West Pty Ltd and Region 6 (Inner West and Southern) was operated by Transit Systems West Pty Ltd. The combined regions comprised of six depots and 855 buses.

Emergency evacuation procedures

1.21 The operator's Standard Work Procedure SWP015 *Emergency Evacuation Procedures for all Buses*[3] documented that the safe evacuation of staff and passengers from a bus in the event of an emergency situation was prioritised. The Procedure stated that 'the priority must always be the safe evacuation of a bus and preservation of life'.

1.22 The Procedure also noted that the safety of all staff and passengers was paramount and any compromise in safety required the evacuation procedure to be executed and the driver to assemble evacuees in an upwind location at least 200 metres from the bus (Figure 7).

Figure 7: Excerpt from Transit Systems NSW SWP015 - Note

NOTE: THE SAFETY OF ALL STAFF AND PASSENGERS IS PARAMOUNT. IF THE SAFETY OF THE DRIVER OR PASSENGERS IS COMPROMISED IN ANY WAY THEN THE FOLLOWING PROCEDURE MUST BE FOLLOWED BY THE DRIVER TO EVACUATE THE BUS AND ASSEMBLE UPWIND OF THE BUS AT A MINIMUM OF 200 METRES.

Source: Transit Systems NSW

1.23 The Procedure included several safety and environmental considerations for the driver when evacuation was deemed necessary (Figure 8).

[2] Bus Operator Accreditation was required in NSW for all operators of public passenger transport services that carry eight or more passengers in buses or coaches. See section on Bus Operator Accreditation Scheme below for further information.

[3] Version date 15/09/2020

Figure 8: Excerpt from Transit Systems NSW SWP015 – Safety and Environmental Considerations

Safety and Environmental Considerations

- Staff are to ensure passengers safety and their own safety first before consideration is given to attempt to extinguish the fire.
- Staff members must not place themselves or any other persons at unnecessary risk trying to put out a fire.
- Bus must not be driven or re-boarded by driver or passengers until instructed by an authorised and technically qualified person.
- Where practicable and safe to do so, the bus driver is to park the bus as far away as possible from people, community and buildings.
- Smoke inhalation must be avoided at all times to remove the risk of respiratory disorders or serious health implication following an accident.

Source: Transit Systems NSW

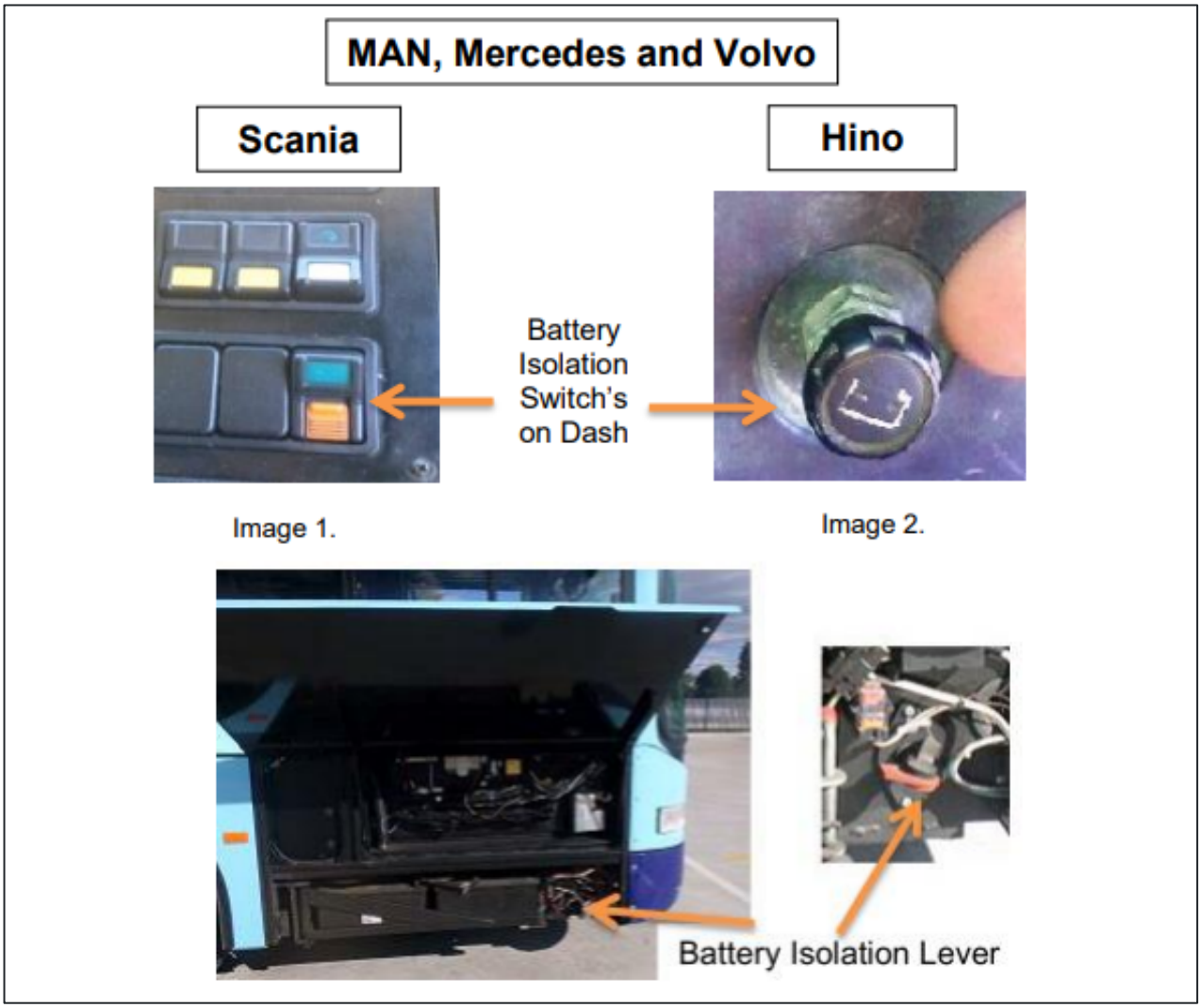
1.24 The Procedure outlined several pre-requisites for its implementation, including that the driver must have been trained in and understand the practical use of a dry chemical fire extinguisher.

1.25 In the event of a fire in the engine bay and/or onboard the bus, the Procedure documented 14 items, including the following first six instructions:

- Remain Calm and have safe control of the vehicle.
- In the event of the driver becoming aware of the fire, every effort is to be made to park the bus, as far from hazards as is practicable and in the safest manner to allow passengers to alight bus safely.
- Apply the Main Park Brake and put engine in neutral and activate the hazard lights.
- If possible, shut down engine and open front and rear bus doors if safe to do so. If in unsafe situation, use front door only. Shut off all electrics. Put on your safety vest.
- Assist passengers, including those with disabilities, to alight bus, monitor passenger safety and move to a safe area upwind of bus and at a safe distance of at least 200 metres.
- If safe to do so, fight any flare-up residual fire with the bus fire extinguisher.

1.26 The bus fire procedure also instructed a driver to 'lift hatch under drivers [sic] window and turn off bus electrics using isolation lever as per image 1 & image 2 below', if safe to do so. The images provided in the Procedure for battery isolation did not show an example of the battery isolation switch fitted to the involved bus model (Figure 9).

Figure 9: Excerpt from Transit Systems NSW SWP015 – Battery isolation switches



Source: Transit Systems NSW

1.27 Transit Systems published the 'Driver Guidelines Handbook' which included a section titled 'Getting Help'. This section included a page for 'Bus fire' (Figure 10) which covered bus driver actions in the event of a thermal incident or bus fire.

Figure 10: Excerpt from Transit Systems Driver Guidelines Handbook – 'Bus fire'

GETTING HELP

#5 Bus fire

ACTIVITY

Bus fire

POTENTIAL HAZARD/RISK

- Injury or death
- Vehicle damage
- Financial impact
- Reputational damage

SAFE METHOD/CONTROL MEASURE

In the event of a thermal incident or bus fire, ensure you:

- Remain calm.
- Slow the vehicle in a controlled manner and stop and secure the vehicle.
- **Turn off the bus, switch off the battery and in the case of CNG powered buses, isolate the gas.**
- Open all doors and evacuate the bus, directing customers to a safe location up-wind and off the road (if possible).
- **Call 000** by mobile phone. Do not enter the bus or allow customers to re-enter the bus under any circumstances.

DRIVER GUIDELINES HANDBOOK | 112

Source: Transit Systems NSW

Driver information

1.28 At the time of the fire, the driver of MO9994 had four years' experience operating buses. They began driving public passenger buses in 2018 and joined TSNSW in 2020. The driver held a valid NSW driver licence and Transport of NSW (TfNSW) Bus Driver Authority.

1.29 On commencing employment with TSNSW, the driver received induction training and completed units of competency as part of TLI31216 Certificate III in Driving Operations (Bus). The driver also completed TLIF2006: Apply accident-emergency procedures with the bus operator.

1.30 The driver reported that their induction training consisted of practical 'buddy' sessions on buses with driver trainers. The driver recalled that their induction training centred on learning bus routes and confirming the driver's competence in operating the bus under normal conditions on public roads. According to the driver, the training was not formal, but rather a confirmation of their ability to operate a bus, due to their previous experience.

1.31 TSNSW's training of its drivers included a fire extinguisher assessment module. This module was made up of a series of written multiple-choice questions designed to evaluate a participant's knowledge of fire extinguisher use. The training did not involve the practical use or discharge of a fire extinguisher.

1.32 The driver reported that they did not receive fire extinguisher training but did receive emergency evacuation training the day they joined the company. The driver could not recall having received training in the use of the emergency battery isolation switch.

1.33 OTSI reviewed training records provided by TSNSW for the involved driver. The driver completed written and verbal assessments which included some content of Standard Work Procedure SWP015 *Emergency Evacuation Procedures for all Buses.*

1.34 Part 4 of the bus operator's driver training for TLI31216 was titled 'Trainee Observation / Demonstration of Assessment' and required application of a direct observation methodology (Figure 11).

Figure 11: Excerpt from Part 4: Transit Systems 'Cluster Observation / Demonstration Assessment'

This assessment requires the application of the following assessment methods:

- **Direct Observation** by the Trainer/Assessor of the Trainee performing or demonstrating a range of tasks and being assessed against the performance benchmarks and assessment criteria outlined within the observation and demonstration checklist. This method of assessment not only assesses skills but also assesses knowledge during its practical application. The Trainer/Assessor is to observe the Trainee's demonstrated skills and knowledge during the performance of practical assessment tasks.

All tasks must be observed in order to gather sufficient evidence to make the assessment decision. Trainers/Assessors are to apply the assessment procedure outlined in the applicable training and assessment strategy. During the observation, the Trainer/Assessor is to record in the observation column what skills and knowledge were actually observed and make comment about the standard of performance achieved by the student. It is **mandatory** that the Trainer/Assessor make meaningful comments and records feedback for the student to monitor their progress and identify opportunities for improvement.

Source: Transit Systems NSW

1.35 On 21 September 2020, the driver was assessed by a Trainer/Assessor as having practically demonstrated the competency requirements for following work health and safety procedures.

1.36 On 25 September 2020, the driver was assessed by a Senior Trainer or Trainee's Supervisor (as required by the bus operator) as competent in following work health and safety procedures, completing the workplace orientation and induction procedure, and applying accident and emergency procedures.

1.37 TSNSW documented a requirement for drivers to complete a yearly online refresher on emergency fire procedures.

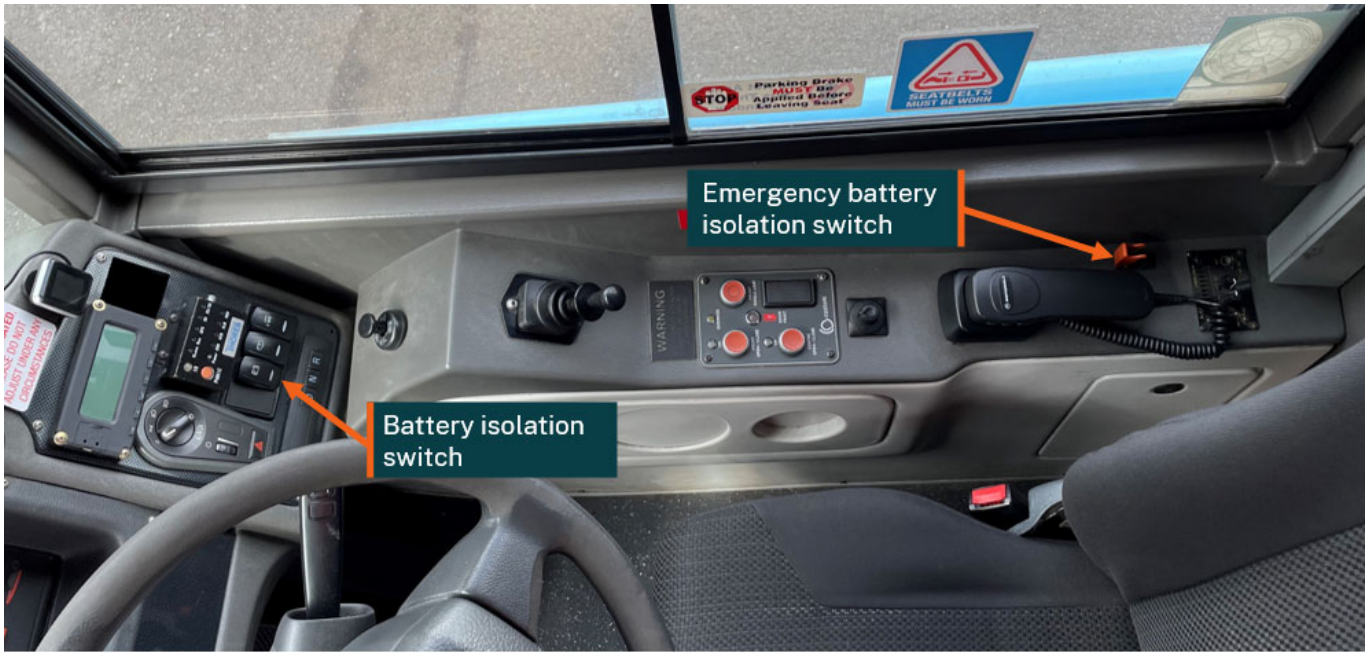
Bus information

1.38 The bus involved in the incident was a 2016 Volvo B7RLE, registered in NSW as MO9994, and powered by a Volvo six-cylinder turbo charged diesel engine. It was fitted with a Custom Bus Australia (Custom) CB80 body. MO9994 was procured under TfNSW Bus Panel 2 specifications in July 2016.

1.39 MO9994 had a fleet number of 1353 and Vehicle Identification Number of YV3R6R726GA175649. At the time of the fire, the bus had travelled approximately 461,000 kms.

1.40 MO9994 had a manually operated battery master switch located on the driver's instrument panel (Figure 12). MO9994 had this manual switch fitted as well as a second emergency isolation switch fitted by the bus body Original Equipment Manufacturer (OEM).

Figure 12: Driver console main battery switches from exemplar bus



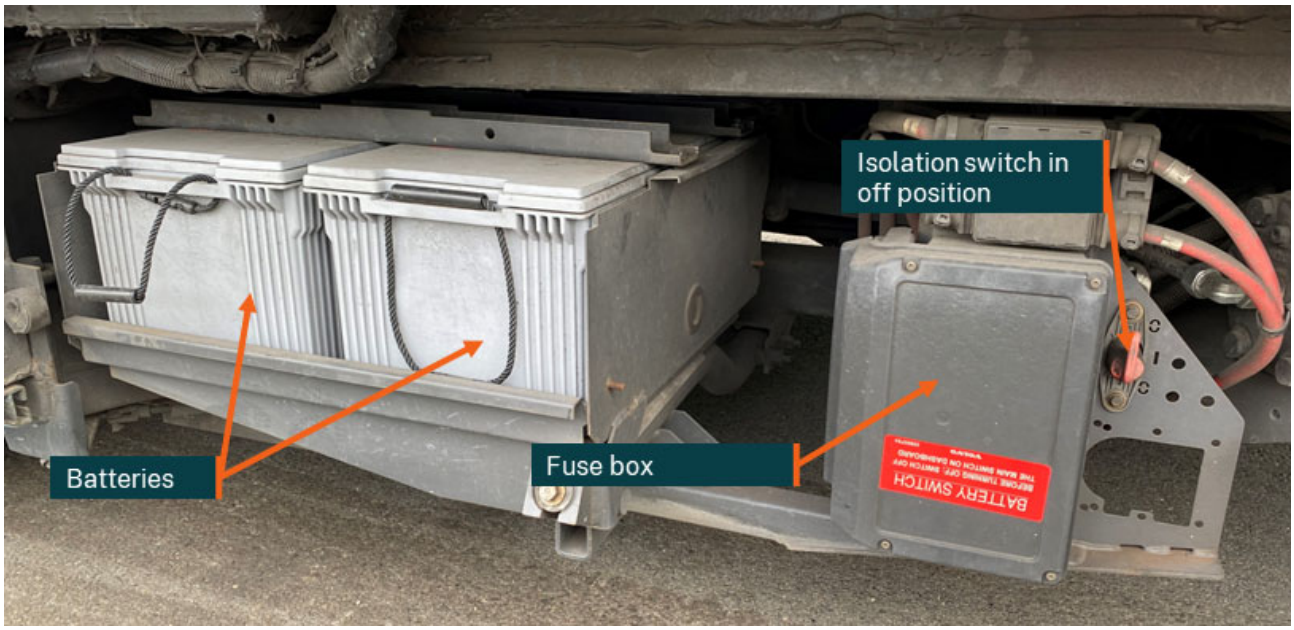
Source: OTSI

1.41 Electrical power to the bus body was supplied by two 12-volt batteries connected in series, providing 24-volts to the chassis, body, and electrical accessories. The batteries were located in an external swing out compartment located on the chassis, under the driver's compartment floor (Figure 13, Figure 18).

1.42 Electrical circuits are protected by fuses against faults, such as a short circuit. A fuse protects a system or equipment from overload and short circuit faults by cutting off the power to them. It achieves this by melting or vaporising the fuse element so that there is no physical connection or conductive path for the current flow through.

1.43 A fuse box installed by the chassis OEM, Volvo, was mounted near the battery box (Figure 13).

Figure 13: Batteries and fuse box

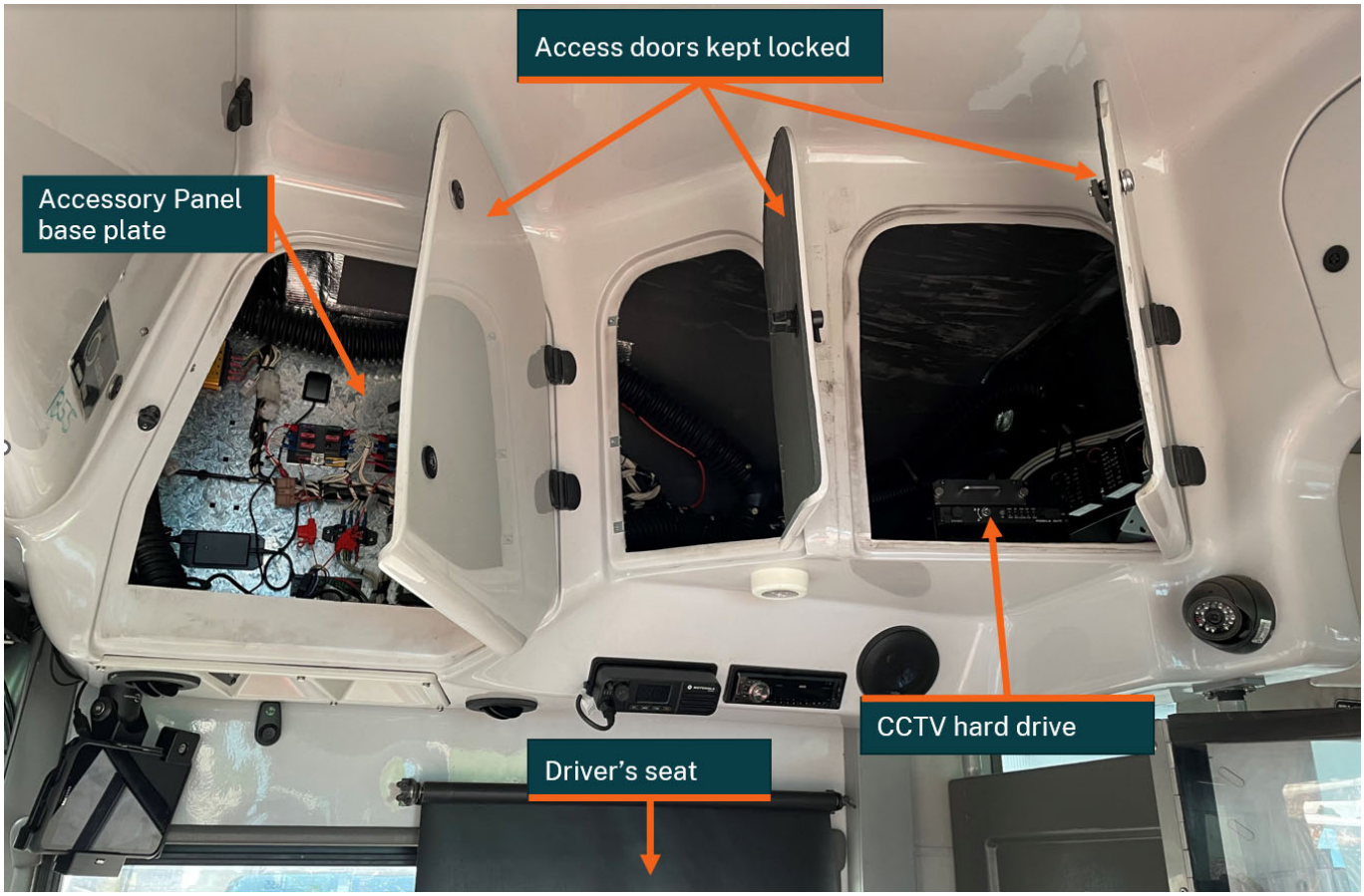


Source: OTSI

1.44 The Accessory Panel was located inside a compartment above the driver's position, and accessible via three access doors, which were locked by the operator and accessible only for maintenance purposes (Figure 14, Figure 23). The compartment contained items such as the closed circuit television (CCTV) hard drive, two-way radio, FM radio, air conditioning controls, Green Road[4] system connections and other various electronic components and fuse boards.

[4] The Green Road system provided real-time visibility to driver events such as fatigue or phone usage as well as telematics events such as harsh braking or cornering.

Figure 14: Accessory Panel above driver's seat in exemplar bus MO9992



Source: OTSI

1.45 Power to the Accessory Panel was supplied by a 6 mm diameter cable, with a continuous rated ampacity[5] of 27 amps (see *Electrical circuit design and protections* for further information).

1.46 MO9994 was last inspected as a part of the Heavy Vehicle Inspection Scheme on 18 May 2022. The bus passed this inspection without any defects detected, with the examiner commenting that some battery acid was evident around the battery tray.

1.47 Maintenance records documented that MO9994 was last serviced on 5 July 2022, in accordance with the normal maintenance schedule, for a major 60,000 km interval service.

1.48 The driver recalled at interview that on the day of the incident they reported a coolant system low level fault, and the bus required refuelling prior to beginning the first passenger service. The driver reported that they did not identify any other issues and the bus was operating normally in the period leading up to the occurrence.

1.49 Maintenance records showed that on 20 April 2022, a driver monitoring system, Green Road Video Sense Pro, was installed on MO9994. While the hardware was located around the driver dash panel, power was taken from the Accessory Panel in the console above the driver's seat. This system was a low current type, protected by two inline 7.5 amp fuses designed to open circuit if the system was compromised.

[5] Ampacity is the maximum current carrying capacity of a component measured in amps. This capacity is the maximum amount of current a cable can withstand before it heats beyond the maximum operating temperature.

Transport for NSW asset management framework

1.50 TfNSW was the lead transport agency of the NSW Government at the time of the incident. Its functions were set out in the *Transport Administration Act 1988* (NSW). These functions included a responsibility for procurement and ongoing management of transport infrastructure, vehicles, rolling stock and vessels.

1.51 To discharge these functions, TfNSW developed an Asset Management Framework (AMF) which included:

- a Transport Asset Management Policy
- TfNSW asset management standards
- TfNSW project delivery standards
- TfNSW configuration management framework and engineering assurance standards.

1.52 The elements of the AMF placed obligations on TfNSW to undertake engineering assurance on the infrastructure, vehicles, and vessels that it procured. To meet these obligations, the procurement of new buses in NSW was conducted utilising specifications described in the TfNSW Bus Procurement Panel.

1.53 At the time of the incident, TfNSW had a Configuration Management Plan (CMP), T MU AM 04001 PL. This document was part of the AMF and set out the requirements for managing TfNSW assets, including buses.

1.54 The Asset Management Branch (AMB) of TfNSW was the authority on standards for transport assets across NSW. AMB was responsible for developing engineering governance, framework, and standards to assist industry deliver assurance of safety and construction for the whole life of the asset (design, construction, commissioning, and operation).

1.55 TfNSW's 2019 publication '*Mounting & Installation of Electrical Equipment*'[6] standard related to mounting of electrical components both at the time of construction and post build modifications. This standard detailed both Australian and international electrical standards and guides. This publication did not apply to the build of MO9994 in 2016.

Battery isolation

1.56 Bus Procurement Panel specifications were introduced by TfNSW in March 2012, with the aim to improve standardisation of the NSW bus fleet. OEMs were required to provide a written response to Bus Panel requirements with details on how the asset complied with each specification.

1.57 As a result of evolving Bus Panel requirements, the present NSW bus fleet was built under differing Bus Panel specifications. A common requirement was the ability to isolate electrical power from the battery to the bus if required. The number, location and function of battery isolation switches was not consistent throughout the fleet.

[6] T BU FL 01701 ST, Version 1.0, issue date 03 April 2019

1.58 TfNSW advised OTSI that a 'type approval' for a new bus model, delivered under the Bus Procurement Panel program, was conducted by TfNSW when the first asset was delivered. Following the first delivery, individual operators then conducted their own acceptance testing procedure, in accordance with TfNSW requirements, for all subsequent buses procured.

1.59 Bus Panel 2 specifications were introduced in August 2015 and applied to the involved bus, MO9994. Bus Panel 3 specifications applied from April 2020.

1.60 TfNSW's Bus Panel 2 requirements for two door diesel city buses specified that 'a double pole battery isolating switch must be provided adjacent to the batteries to isolate power to the bus if required'.

1.61 TfNSW reported that Volvo Bus Australia was the 'Prime Contractor' responsible for the supply of a complete bus, including the body. This applied to bus MO9994. In addition, TfNSW advised that 'the Prime Contractor arrangement, in addition to other performance guarantee instruments has been in place for many years to protect TfNSW interests in the event a local bus body builder ceases trading. This arrangement has been relied on several times. A PRIME Contractor arrangement also eliminates warranty disputes between body builders and chassis suppliers as there is a single party responsible for the complete bus'.

1.62 Volvo submitted a response to the TfNSW tender for Bus Panel 2. Volvo included in their response for two door diesel city buses that their supplied assets would "partially comply" with the double pole battery isolation switch specification, as a single (Positive) pole only isolation switch was fitted adjacent to the batteries.

In addition, Volvo documented in their response to this specification that:

> 'Volvo provides an electrically operated master switch fitted to the dash for day to day driver operation that allows for the power to be turned off at the end of a shift. Additionally, the vehicle is fitted with a battery isolator located in the battery box for complete isolation of all power to the vehicle as required'.

Related reports

Bus Fire 2169ST Camperdown[7]

1.63 On the afternoon of 13 January 2022, articulated bus 2169ST caught fire and came to a stop adjacent to the intersection of Parramatta Road and Ross Street, Camperdown.

1.64 The bus was travelling westbound with the driver and 12 passengers on board. From the closed circuit television footage, the driver appeared to observe a passing motorist attempting to gain their attention from the next lane. Shortly after, the driver noticed smoke from the rear of the bus, stopped the bus and safely evacuated all passengers.

1.65 Following notification to OTSI of a thermal incident or bus fire, additional information from the bus operator would be requested by OTSI. This request was made using a Bus Fire / Thermal Incident Information Collection Form. Information requested included the date that the driver of the incident bus was last trained in evacuation procedures and the use of fire extinguishers.

[7] Full report available at www.otsi.nsw.gov.au

1.66 For the calendar year 2021, OTSI received 52 information collection forms from the involved bus operator, Transit Systems West (TSW). Of the 52 forms received, 15 (28.8%) documented 'Ex-STA [State Transit Authority] – No records kept' for the date the involved driver was last trained. Similarly, for the calendar year 2022, 46 information collection forms were received, with 16 (34.7%) noting for training, 'Ex-STA – No records kept'.

1.67 This information indicated that for 31 drivers, and the driver of 2169ST, there was no supporting evidence that training in evacuation procedures and/or the use of a fire extinguisher was provided by the operator since the commencement of the TSW contract in July 2018. In addition, the involved operator did not have documented assurance records of training provided to their drivers under STA, in absence of the provision of training under the TSW contract.

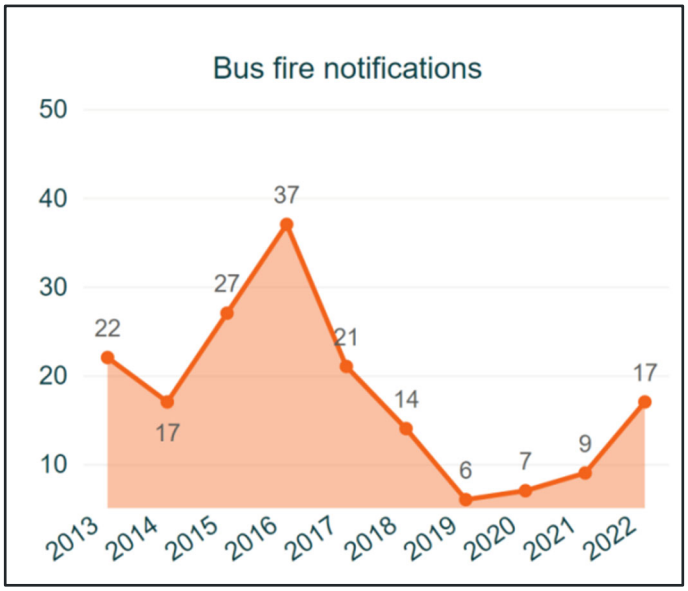
1.68 OTSI identified several safety factors, including:

- There was no supporting documentation to assure that the driver of 2169ST was provided with emergency training during their employment with the involved bus operator, or with the previous operator
- The involved bus operator did not have documented assurance records of training provided to their drivers under the previous operator, in absence of the provision of training under their own contract.

OTSI Bus Fire Safety Report

1.69 The OTSI Bus Fire Safety Report – *Bus Fires and Thermal Incidents in NSW from 2013 – 2022*,[8] reports that in the period from 2013 to 2022, OTSI recorded 177 bus fire notifications in NSW (Figure 15).

Figure 15: OTSI bus fire notifications 2013-2022

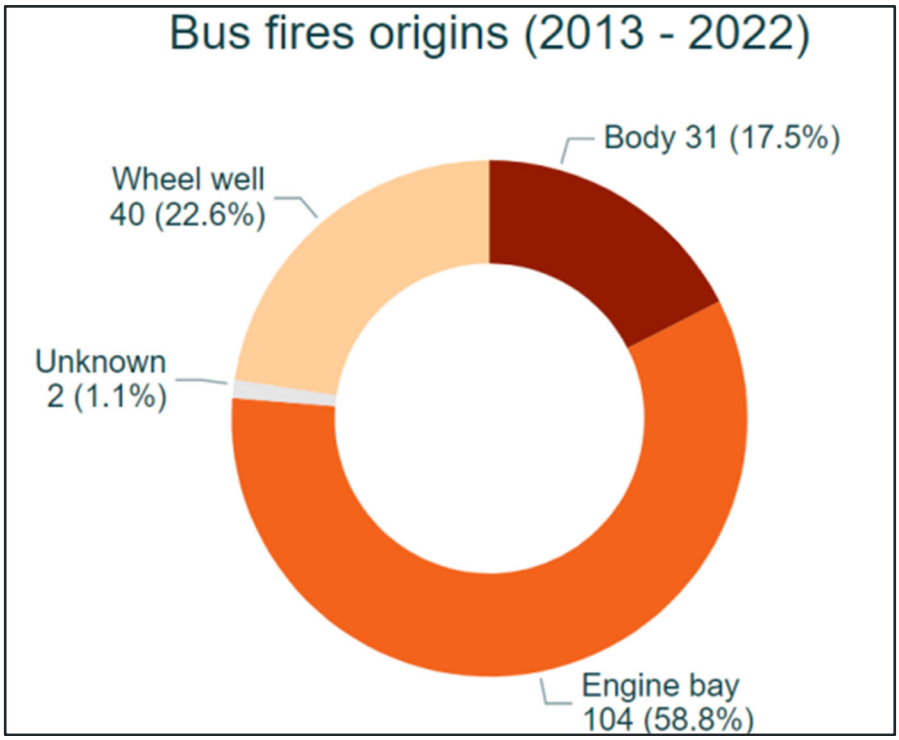


Source: OTSI

[8] Bus Fire Safety Report – Bus Fire and Thermal Incidents in NSW 2013 – 2022 located at Bus Fire Safety Report (nsw.gov.au)

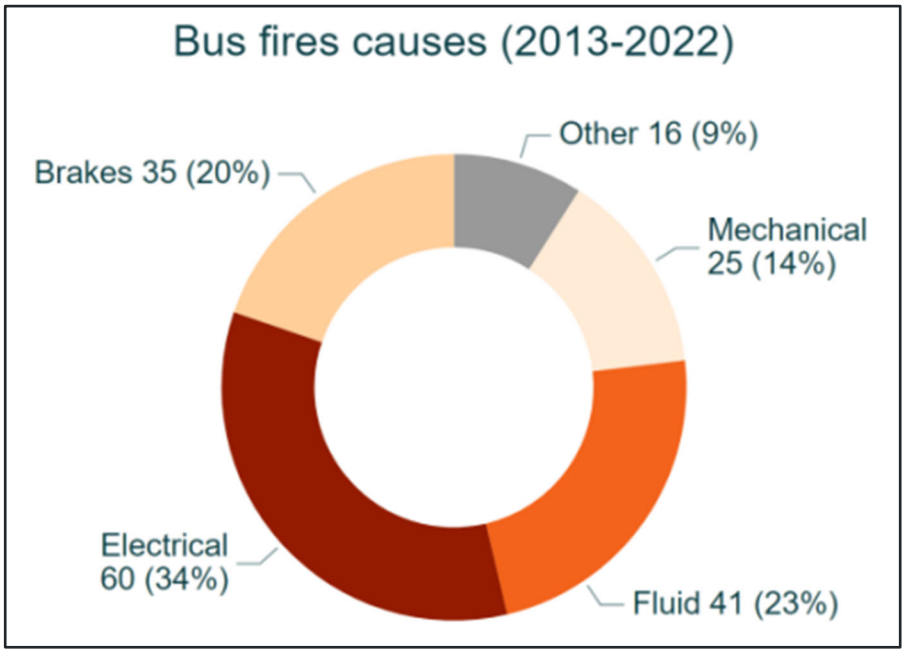
1.70 The Bus Fire Safety Report identified that in the 10 years between 2013 and 2022, fires located in the engine bay were the most common (Figure 16), with electrical faults identified as the leading cause (Figure 17).

Figure 16: Bus fire origins



Source: OTSI

Figure 17: Bus fire causes



Source: OTSI

Part 2 — Analysis

Introduction

2.1 The investigation focused principally on the factors that contributed to the bus fire, the immediate emergency response and identification of safety improvement opportunities.

2.2 The findings of related OTSI investigations and the annual summaries of bus fires in NSW, emphasise the importance of securing bus wiring cables, looms, and harnesses, to prevent movement, chafing or vibration while in service, and regular inspection of electrical wiring, as integral factors in the prevention of thermal events and fires.

Examination of the bus

2.3 Following the incident, OTSI investigators inspected the involved bus, MO9994.

2.4 The bus operator, Transit Systems NSW (TSNSW), provided exemplar buses, registered MO6705 and MO9992 (Figure 18), for comparison. This allowed OTSI to better understand the layout of MO9994 prior to the fire damage. Representatives from the bus operator and the bus chassis manufacturer, Volvo Bus Australia (Volvo), attended this inspection.

2.5 MO9994 (body number G7101-01) was part of the delivery of three buses to TSNSW with exemplar buses MO6705 (body number G7101-02) and MO9992 (body number G7101-03).

Figure 18: Exemplar bus MO9992

Source: OTSI

2.6 Footage from the bus closed circuit television system could not be reviewed due to fire damage of the associated hard drive.

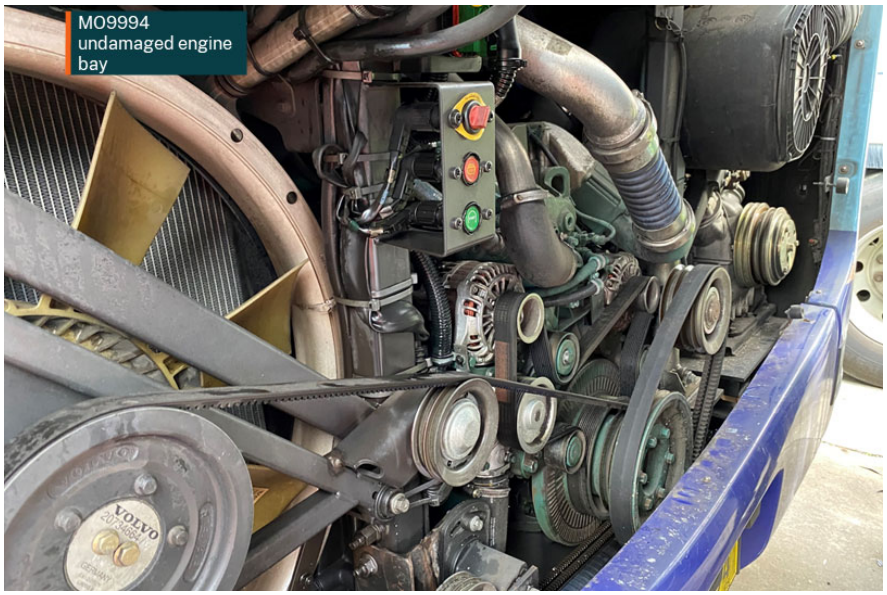
2.7 The bus body was destroyed by fire. The lower external body panels below the window line were still intact (Figure 19).

Figure 19: MO9994 after the fire

Source: OTSI

2.8 The engine bay area was undamaged by fire (Figure 20).

Figure 20: Undamaged engine bay



Source: OTSI

2.9 An inspection of the driver's cabin identified fire damaged electrical cabling, near the Accessory Panel above the driver's seat (Figure 21).

Figure 21: Damage to driver's position and overhead Accessory Panel

Source: OTSI

2.10 Inspection of the Accessory Panel identified evidence of high heat damage on the panel base plate, near the power supply positive post (Figure 22). All components mounted on this panel were destroyed. Heat patterns on the bus body panels, to the rear of the Accessory Panel, indicated areas of more intense heat.

Figure 22: Heat damaged Accessory Panel

Source: OTSI

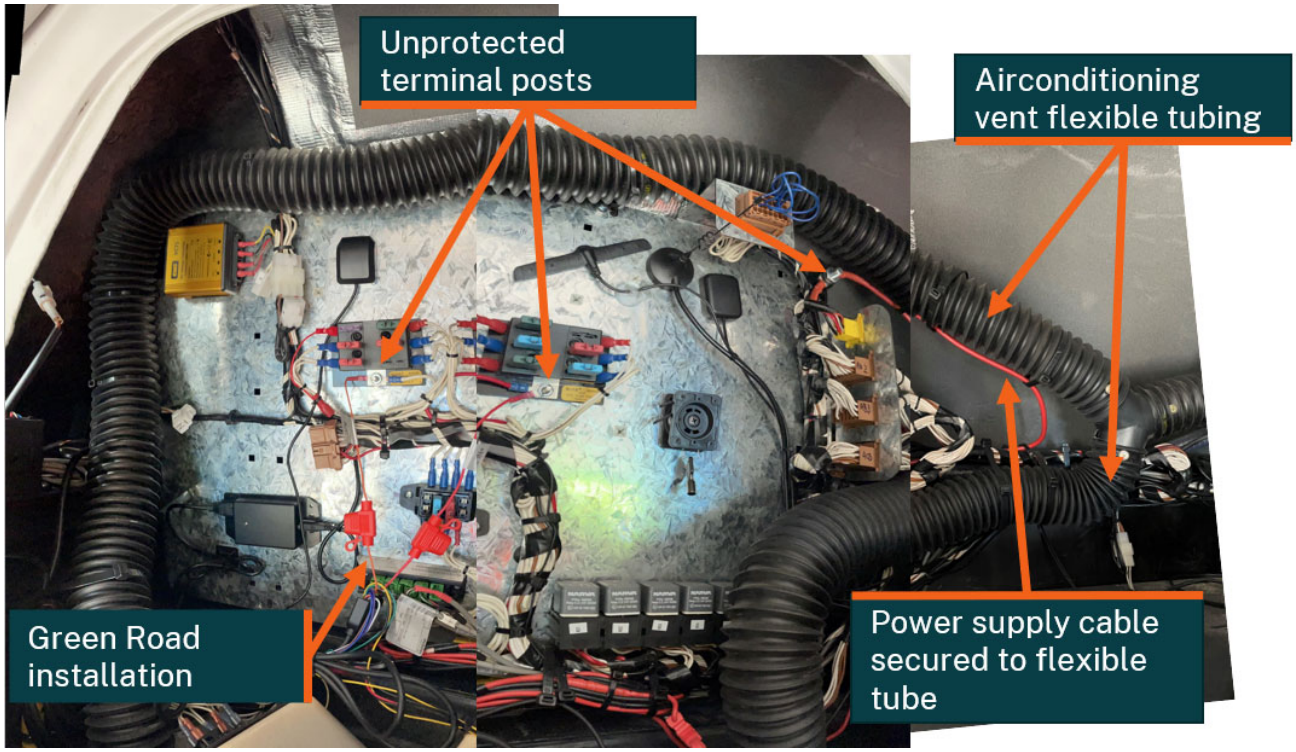
2.11 OTSI identified several uninsulated terminal posts on the Accessory Panel in the exemplar buses. These unprotected posts increased the risk of an electrical short circuit[9] when the circuit was live if contact was made with conductive materials.

2.12 Electrical arcing was evident on the cable likely connected to the main B+ terminal post of the Accessory Panel located above the driver's position.

2.13 OTSI noted that the air conditioning flexible tubing in exemplar bus MO9992 was mounted near metal components, including unprotected terminal posts, and associated wires on the Accessory Panel (Figure 23, Figure 24). The flexible tubing was constructed of a continuous wire coil covered in plastic.

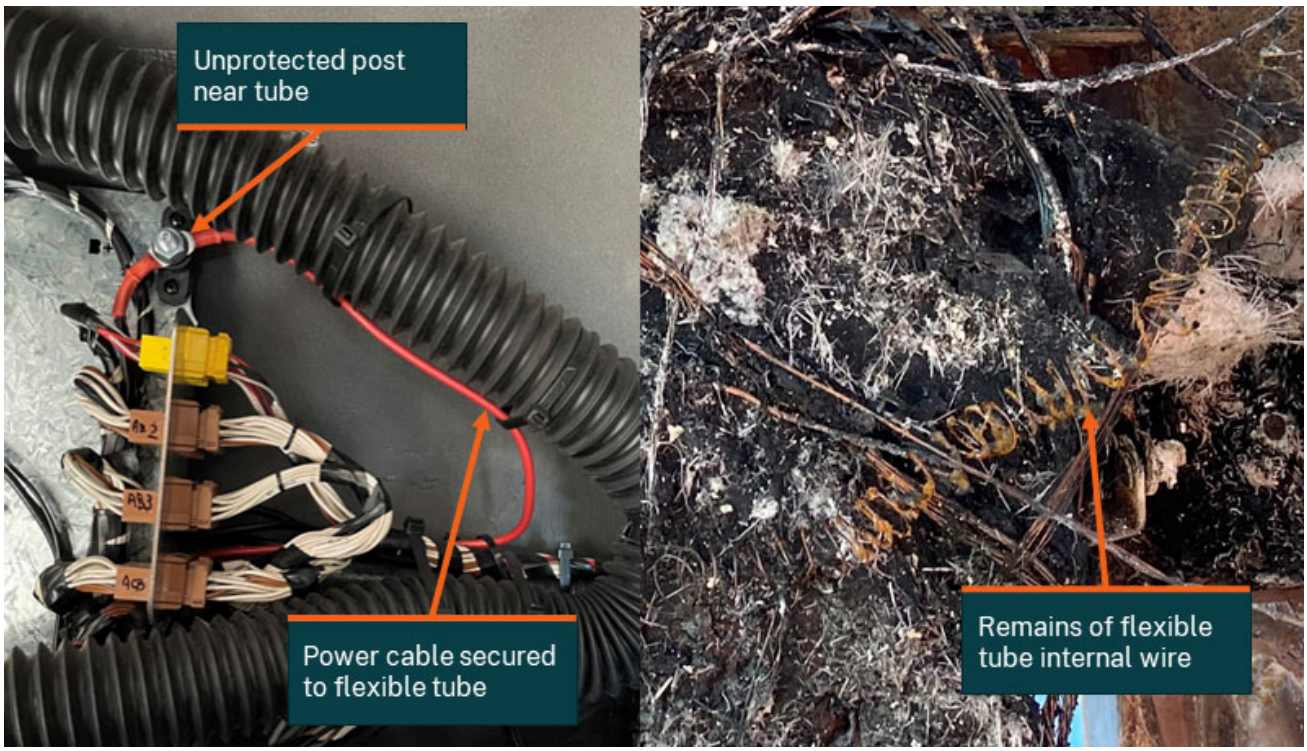
[9] A short circuit is an unintended electrical connection between current carrying parts. A short circuit is a situation in which a faulty connection or damaged wire causes electricity to travel along the wrong route and damage an electrical device.

Figure 23: Internal layout of Accessory Panel in exemplar bus MO9992



Source: OTSI. Note: Figure presented as a collage of three images

Figure 24: Flexible tubing proximity to unprotected post in exemplar bus and MO9994



Source: OTSI

2.14 Movement of this tubing against other surfaces, due to vibration from the bus travelling over irregular road surfaces, could potentially cause abrasion damage to the tubes, exposing the

internal metal coil. Once exposed, there was an increased risk of the wire contacting nearby live electrical components, such as the power cable or uninsulated posts. A resulting short circuit could heat the wire, while live current continued to be present, acting like an electric heater coil.

2.15 Heat generated in the components by a short circuit increased the risk of nearby combustible materials igniting, resulting in a fire. A closer examination of the heat damage in the area around the Accessory Panel revealed a heat pattern that matched the shape of the flexible tube coil (Figure 25).

Figure 25: Spiral heat markings on bus body

Source: OTSI

2.16 The risk of movement could also be attributed to various other influences, such as the installation of aftermarket equipment by a contractor, or technicians conducting regular servicing, which can present a risk of inadvertently moving or dislodging components. If the contractor/technician fails to identify any issues and the cabinet is then locked, the fault may develop without opportunity for regular visual inspection.

2.17 Regular inspection of the electrical system may identify wiring faults before a short circuit occurs. The provision of a wiring diagram facilitates the correct identification of components and assists technicians with inspection and maintenance.

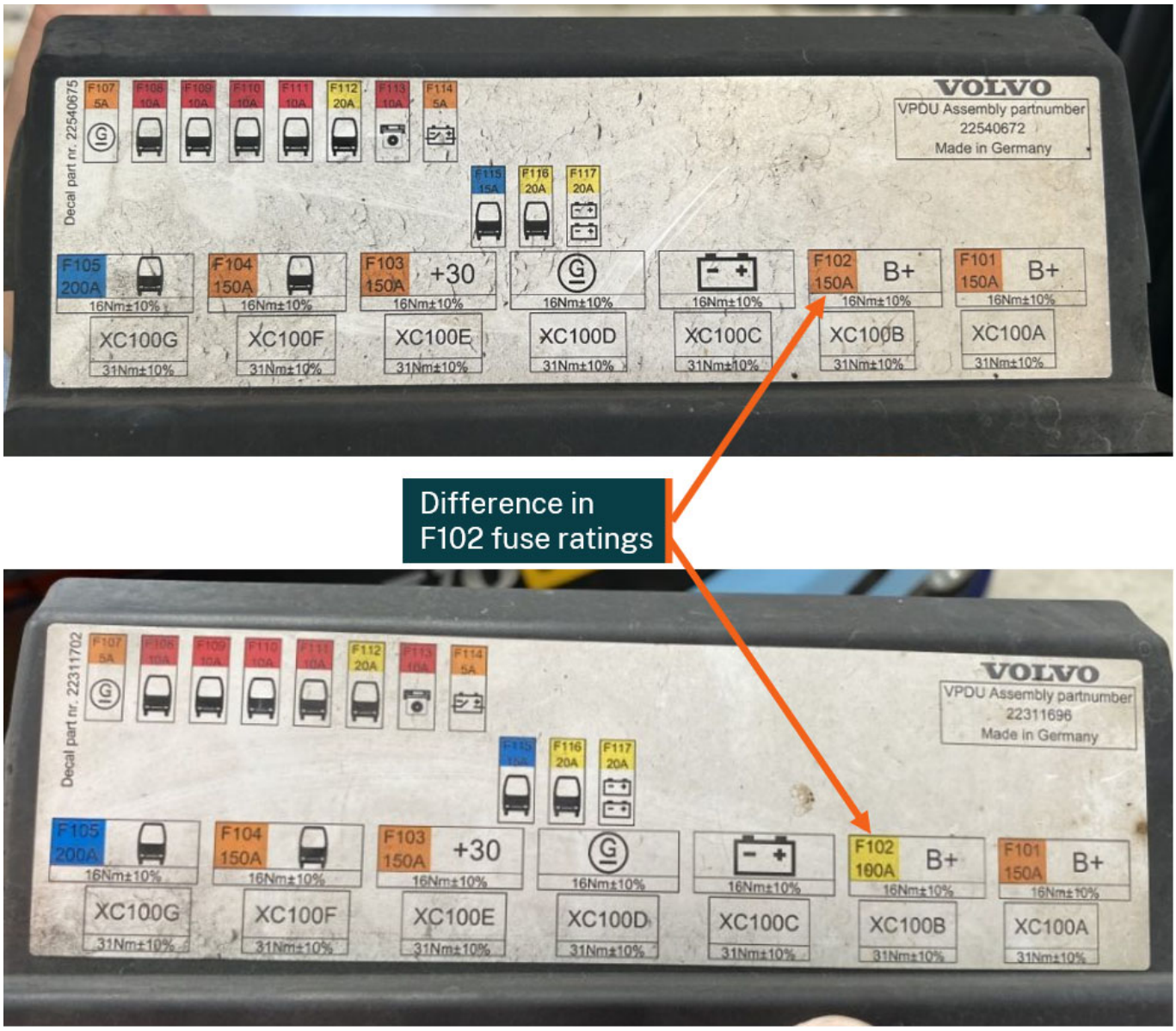
Electrical circuit design and protections

2.18 MO9994 was built to meet TfNSW Bus Procurement Panel 2 specifications, which did not include reference to any electrical Standard, such as Joint Australian/New Zealand Standard AS/NZS 3000:2018 – *Electrical installations (*known as the Australian/New Zealand Wiring Rules).

2.19 Due to the unavailability of supporting evidence, OTSI could not determine the Standard applied for the design and build of the involved CB80 body electrical system.

2.20 OTSI reviewed the Volvo fuse box diagrams, located on the inside cover of the fuse boxes on the exemplar buses, and identified that the F102 circuit fuses differed in rating between the two buses, with a 100-amp fuse in one bus and 150-amp in the other, for the same circuit (Figure 26). The fuse box cover for the involved bus was destroyed by fire.

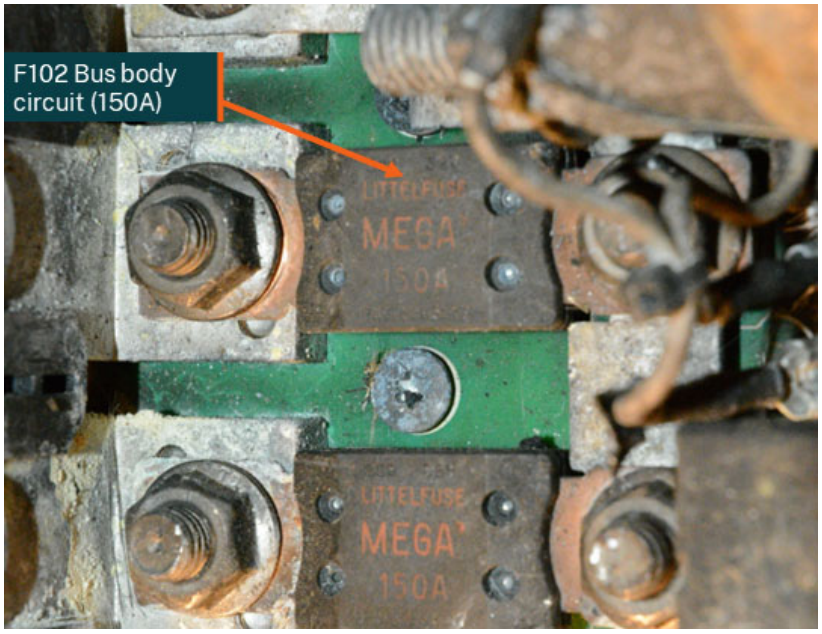
Figure 26: Volvo fuse box layout diagram



Source: OTSI

2.21 The investigation determined that the F102 fuses fitted on MO9994 (Figure 27) and two exemplar buses were rated at 150-amp.

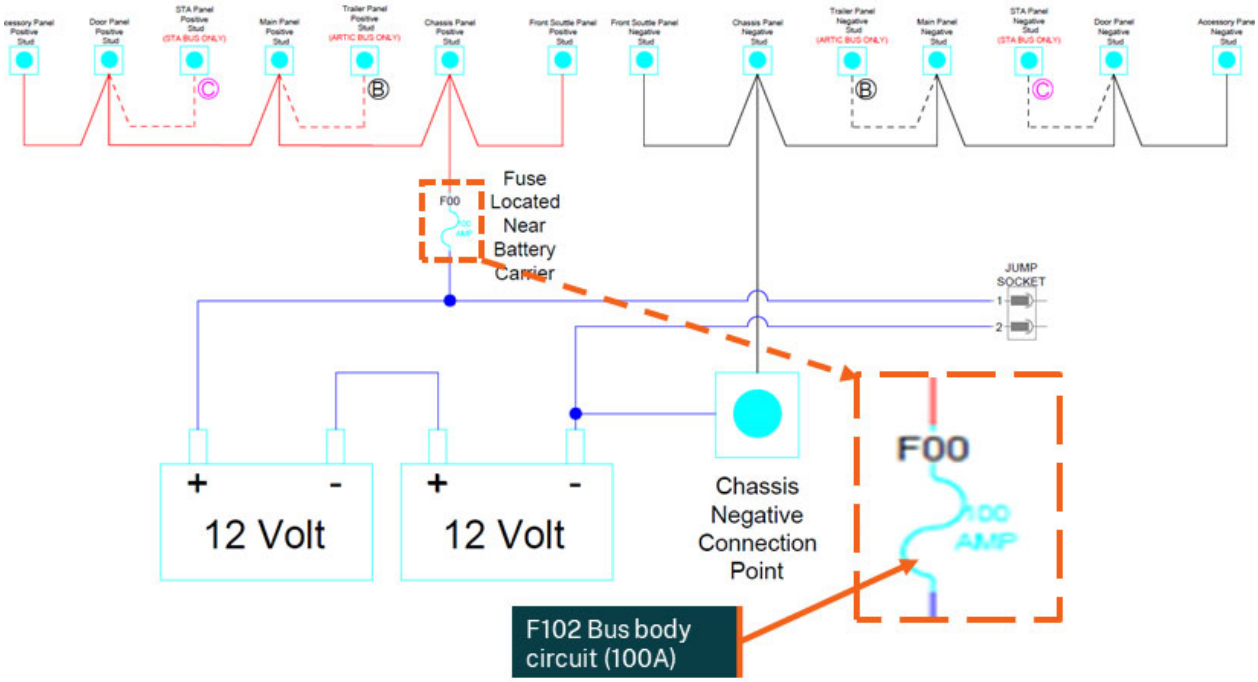
Figure 27: MO9994 fuse F102 post fire



Source: OTSI

2.22 A review of the Custom Metro CB80 Electrical Drawings documented a 100-amp fuse for the F102 Bus body circuit (Figure 28).

Figure 28:Custom electrical drawing for chassis to bus power supply

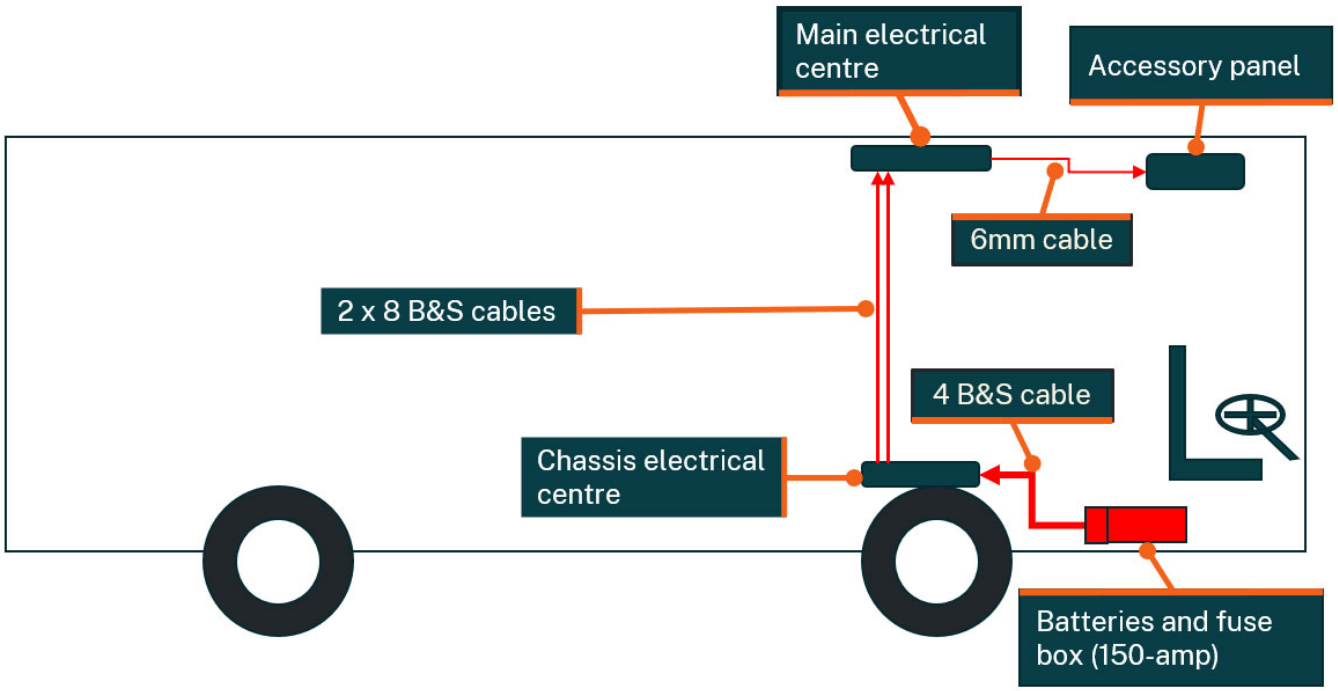


Source: Volvo, annotated by OTSI

2.23 OTSI could not determine a reason for the fuse box diagrams on the two exemplar buses differing to the electrical drawings and fuses fitted on all three buses.

2.24 From fuse F102, a 4 B&S[10] (21.11mm^2) cable was installed to supply power to the bus body circuit and connected to the Chassis Electrical Centre, located above the offside front wheel arch (Figure 29).

Figure 29: Simplified circuit layout

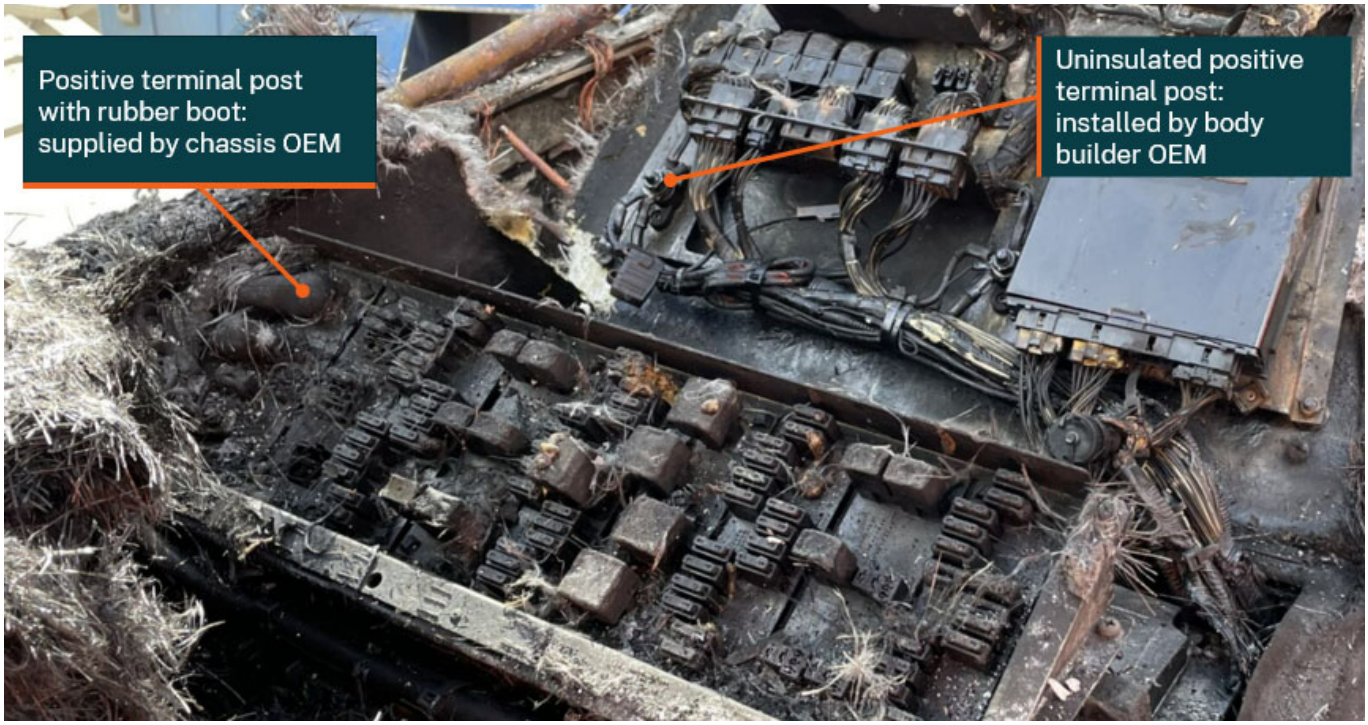


Source: OTSI

2.25 The 4 B&S cable was connected to the Chassis Electrical Centre at an uninsulated metal terminal post (Figure 30), which had been installed by the body builder OEM. OTSI noted that the positive terminal post supplied by the chassis OEM was fitted with a rubber boot.

[10] Brown & Sharpe (B&S) wire gauge also known as the American Wire Gauge; a system used to measure the diameter of a wire.

Figure 30: MO9994 electrical chassis centre post incident



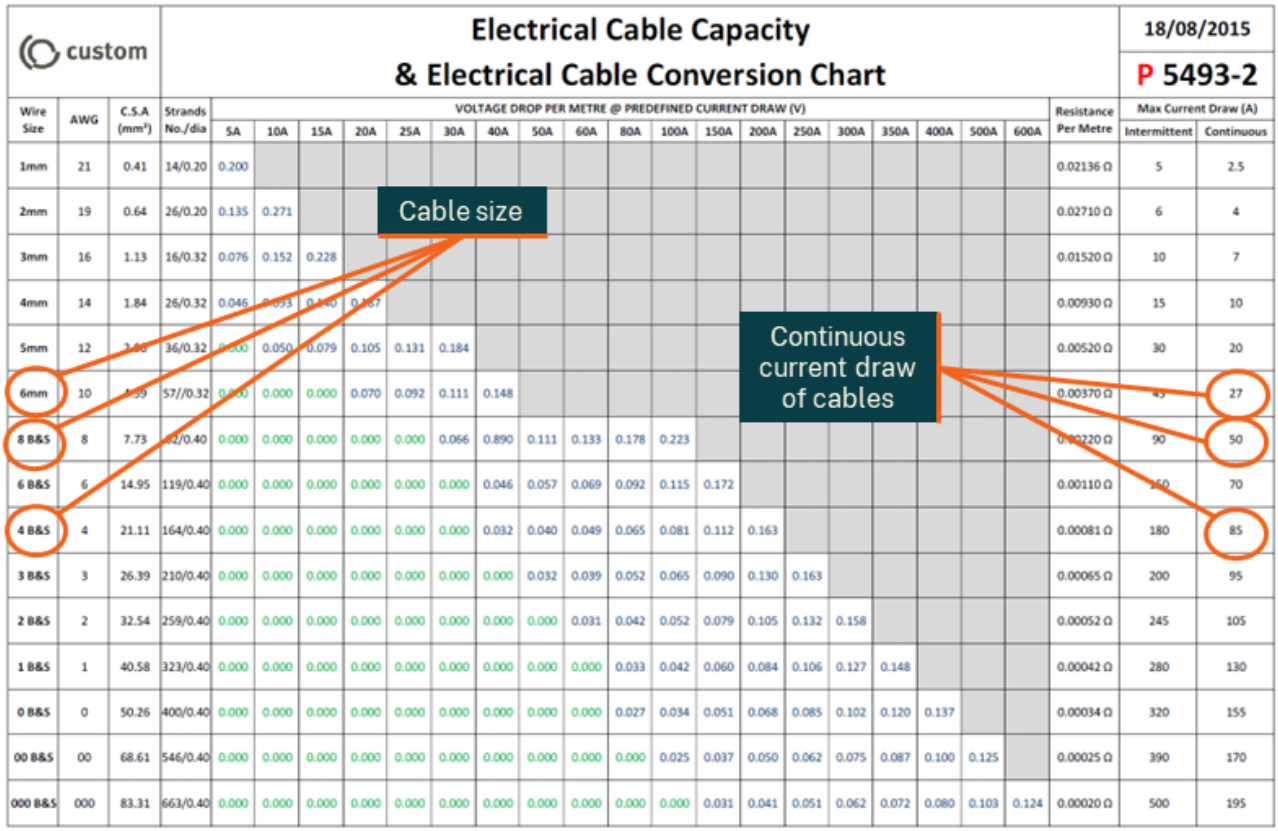
Source: OTSI

2.26 Power from the Chassis Electrical Centre was configured along two 8 B&S (7.73mm^2) cables (continuous rating 50-amps each), to the Main Electrical Centre, located within the air conditioning duct panel directly above the offside front wheel arch (Figure 29). These cables were also connected at an uninsulated metal terminal post in the exemplar buses.

2.27 From the Main Electrical Centre, power to the Accessory Panel above the driver's seat, was provided through a single 6 mm cable (continuous rating 27amps). This cable was connected at an uninsulated metal terminal post in the exemplar buses.

2.28 The configured cables in the electrical system had the following capacities (Figure 31).

Figure 31: Custom electrical capacity chart



custom

Electrical Cable Capacity & Electrical Cable Conversion Chart

18/08/2015

P 5493-2

Wire Size	AWG	C.S.A (mm²)	Strands No./dia	VOLTAGE DROP PER METRE @ PREDEFINED CURRENT DRAW (V)																		Resistance Per Metre	Max Current Draw (A)	
				5A	10A	15A	20A	25A	30A	40A	50A	60A	80A	100A	150A	200A	250A	300A	350A	400A	500A	600A		Intermittent	Continuous
1mm	21	0.41	14/0.20	0.200																			0.02136 Ω	5	2.5
2mm	19	0.64	26/0.20	0.135	0.271																		0.02710 Ω	6	4
3mm	16	1.13	16/0.32	0.076	0.152	0.228																	0.01520 Ω	10	7
4mm	14	1.84	26/0.32	0.046	0.093	0.140	0.187																0.00930 Ω	15	10
5mm	12	3.60	36/0.32	0.000	0.050	0.079	0.105	0.131	0.184														0.00520 Ω	30	20
6mm	10	4.59	57//0.32	0.000	0.000	0.000	0.070	0.092	0.111	0.148													0.00370 Ω	45	27
8 B&S	8	7.73	42/0.40	0.000	0.000	0.000	0.000	0.000	0.066	0.890	0.111	0.133	0.178	0.223									0.00220 Ω	90	50
6 B&S	6	14.95	119/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.057	0.069	0.092	0.115	0.172								0.00110 Ω	150	70
4 B&S	4	21.11	164/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.040	0.049	0.065	0.081	0.112	0.163							0.00081 Ω	180	85
3 B&S	3	26.39	210/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.039	0.052	0.065	0.090	0.130	0.163						0.00065 Ω	200	95
2 B&S	2	32.54	259/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.031	0.042	0.052	0.079	0.105	0.132	0.158					0.00052 Ω	245	105
1 B&S	1	40.58	323/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.033	0.042	0.060	0.084	0.106	0.127	0.148				0.00042 Ω	280	130
0 B&S	0	50.26	400/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.034	0.051	0.068	0.085	0.102	0.120	0.137			0.00034 Ω	320	155
00 B&S	00	68.61	546/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.037	0.050	0.062	0.075	0.087	0.100	0.125		0.00025 Ω	390	170
000 B&S	000	83.31	663/0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.031	0.041	0.051	0.062	0.072	0.080	0.103	0.124	0.00020 Ω	500	195

Source: Volvo Bus Australia – Custom body wiring chart, annotated by OTSI

2.29 AS/NZS 3000:2018- *Electrical installations*[11] stated that overload protection for electrical cables must not exceed 90% of the continuous current rating of the cable. OTSI's examination of MO9994, and two exemplar buses, identified that the bus body electrical circuit was not adequately protected against any potential circuit overload condition.

The three cables in the circuit all had a rated ampacity (27, 50, and 85-amps), significantly below the ampacity of the fuse fitted to protect the circuit (150-amp). In this configuration, the fuse would not provide circuit protection in the event of an electrical fault, such as a short circuit, resulting in increased potential of fire.

Battery isolation switch configurations

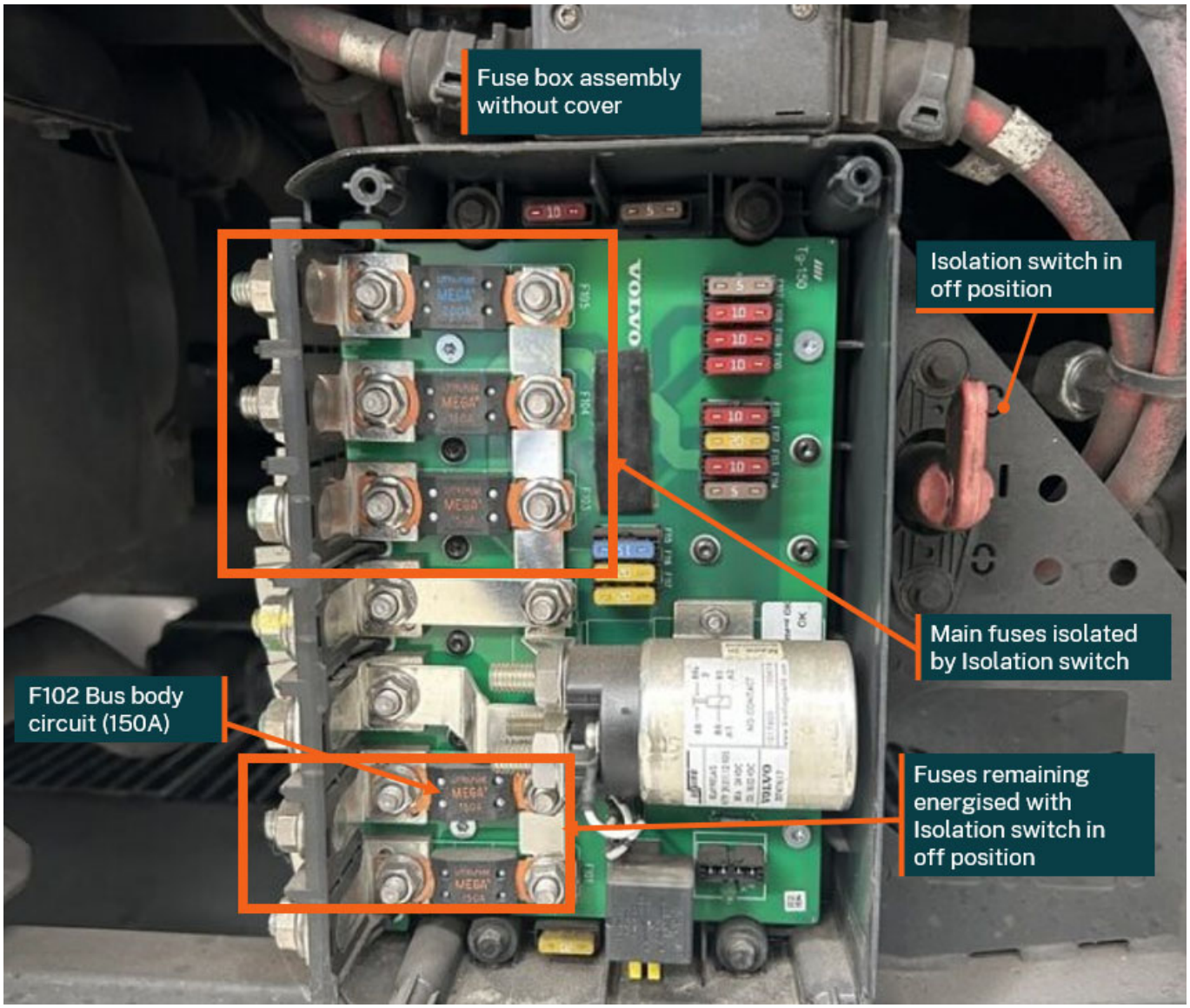
2.30 During the investigation, OTSI identified that all three isolating switches fitted to MO9994, and two exemplar buses, did not fully isolate power from the batteries to the bus body circuit. OTSI's examination of the fuse box identified that when the isolation switch was in the off position, the bus body circuit protected by fuse F102 remained energised.

[11] AS/NZS 3000:2018 paragraph 2.5.3 Protection against overload current

2.31 OTSI performed a series of tests, which involved first isolating the one and/or both switches on the driver console (Figure 12), then isolating the mechanical isolation switch next to the fuse box (Figure 13).

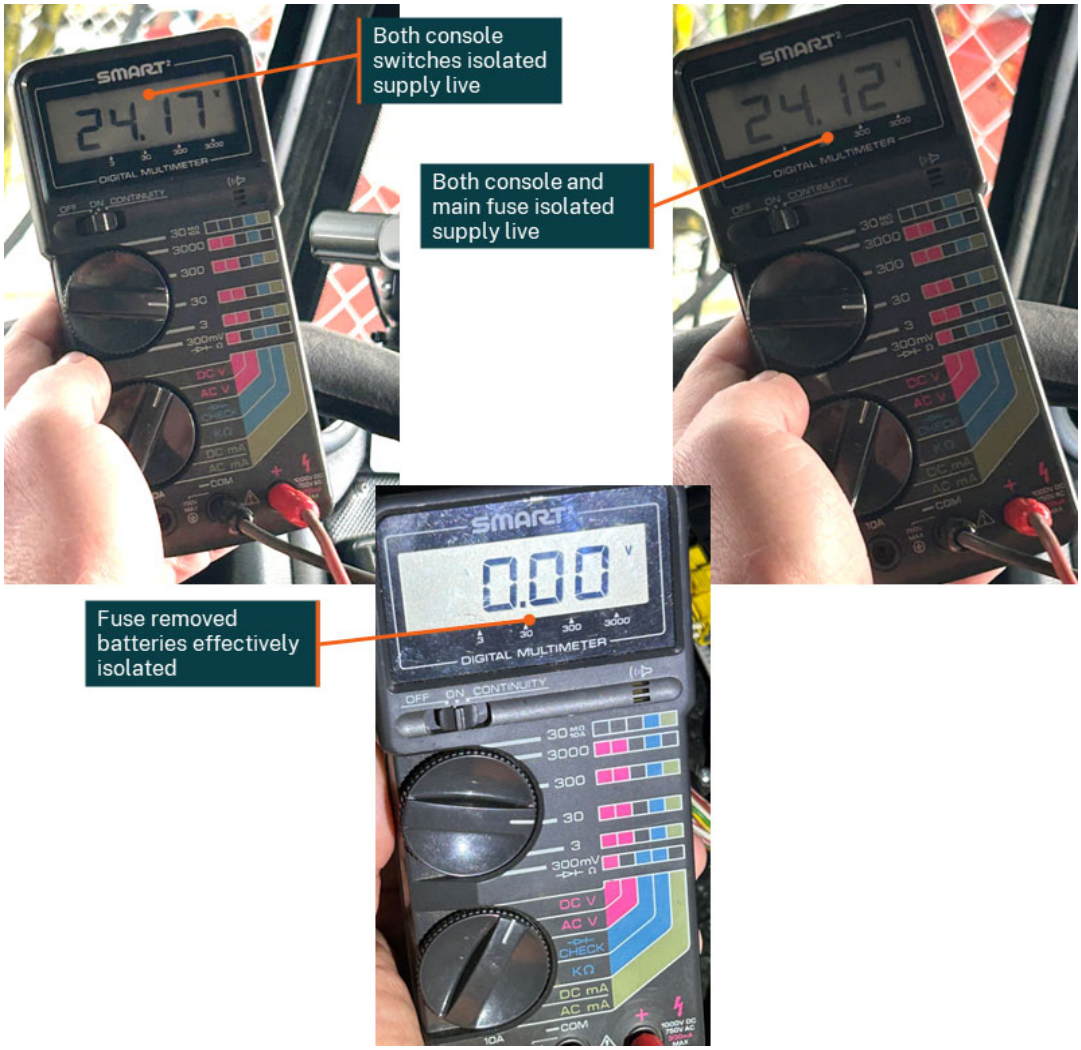
2.32 The isolation of one, two or all three of these switches had no effect on the continued electrical supply to the bus body circuit (Figure 32, Figure 33). The batteries could only be isolated from the bus body by using tools to remove the associated fuse or physically disconnecting the battery leads.

Figure 32: Volvo fuse box in an exemplar bus showing circuit isolation configurations



Source: OTSI

Figure 33: OTSI isolation test results



Source: OTSI

2.33 By removing electrical current from a circuit, before any surrounding components reach their ignition temperature,[12] it is likely that a fire can be prevented before commencement.

2.34 In this incident, early isolation of battery power to the Accessory Panel, where the fire likely initiated, would have removed ongoing provision of a source of energy for the escalation and propagation of the fire.

However, the electrical circuit isolation switches configurations of the involved bus and two exemplar buses did not allow isolation of this circuit.

2.35 Without knowledge of the battery isolation limitations of the involved bus and exemplar buses, the bus operator's procedure to isolate power to the bus using the configured switches was ineffective in removing power from the bus body in an emergency. This system limitation would also be unknown to emergency services and vehicle recovery services, who may use the battery isolation functionality as part of an emergency response.

[12] The ignition temperature of a substance is the minimum temperature that is required to start or cause combustion. The ignition temperature is also known as the ignition point. It is the temperature at which any substance may catch fire and start burning.

Driver training

2.36 While TSNSW documented a requirement for drivers to complete a yearly online refresher on emergency fire procedures, there was no supporting evidence that the driver of MO9994 was provided with emergency refresher training by TSNSW, after their initial induction training.

2.37 The driver of MO9994 was provided with training on commencement with the bus operator in 2020. However, there were no training records to support that the driver received refresher training on emergency procedures and response, in the approximately two years between induction and the incident.

2.38 Without the provision of refresher training in emergency procedures and response, and no practical assessment of the driver's knowledge and competency in managing an emergency response after induction, it was likely that the driver was not effectively trained or prepared to respond to the incident. As such, the driver was not aware of the battery isolation switch functionalities for this bus model, and there was a delay in evacuating the remaining passengers, after the driver detected smoke in the saloon area. This increased the period of passenger exposure to smoke.

2.39 The bus operator did not provide the driver with a suitable level of recent practical training and competency assessment to assure that they could effectively manage the emergency situation, which likely resulted in the delayed evacuation of passengers after the detection of smoke in the saloon area.

2.40 The requirement in the operator's emergency procedures for a driver to isolate power to the bus using the external isolation lever 'if safe to do so', would not have removed energy from the batteries to the involved electrical circuit. While the external battery isolation switch was not engaged by the driver, that switch would not have isolated the involved auxiliary panel electrical circuit in this bus.

2.41 As identified in the OTSI investigation into Bus Fire 2169ST Camperdown, NSW, there is a safety improvement opportunity for TSNSW and other bus operators to review their documentation and driver training programs for bus fires and thermal events to ensure the provision of effective procedures and competency-based, practical refresher training.

Bus operator emergency procedures

2.42 TSNSW's Standard Work Procedure (SWP) SWP015 *Emergency Evacuation Procedures for all Buses* illustrated a series of battery isolation switches (Figure 9). TSNSW Driver Guidelines Handbook '*Bus fire*' stated that a driver should 'switch off the battery' (Figure 10) but did not provide information on the location of battery isolation switches or safety consideration of 'if safe to do so', which was contained in SWP015.

2.43 While SWP015 and the Driver Guidelines Handbook were designed as driver reference and support material, the provision of recurrent practical, competency-based refresher training, by bus operators, should provide drivers with the skills and knowledge to effectively manage a bus fire/thermal event.

2.44 As the Accessory Panel cabinets were locked, the fire commencement site was inaccessible with the onboard portable fire extinguisher.

2.45 However, as the Accessory Panel electrical system could not be isolated from continuous battery power, it is highly unlikely that a portable fire extinguisher would have successfully extinguished the fire if the Accessory Panel was accessible.

Asset configuration management

2.46 At the time of the incident, the battery isolation system limitations had not been identified by the bus chassis or body builder OEMs, TfNSW, or the bus operator. This resulted in incorrect reporting that the involved vehicle configuration was fitted with a battery isolator located in the battery box for complete isolation of all power to the vehicle as required.

2.47 The bus operator did not have access to bus body wiring diagrams for the involved bus or exemplar bus configurations. This included the wiring diagrams from the initial build and wiring diagrams for third party installation of auxiliary electrical equipment in the Accessory Panel location involved in the incident.

2.48 The bus body manufacturer of MO9994, Custom Bus Australia, ceased operating in 2018. Information requested by OTSI as part of this investigation could not be provided by Custom Bus Group, which had taken over Custom Bus Australia's operations.

2.49 The inability to access OEM documentation and service information likely increases the risk to an operator in effectively managing a vehicle throughout its service life. TfNSW had specified that the service life of an asset procured under Bus Panel 2 was 25 years. Additionally, Bus Panel 2 specified that spare parts would be available for a period of not less than 20 years. Notwithstanding TfNSW's prime contractor arrangements, there was no effective assurance that OEM documentation and support would be provided for the service life of these assets.

Safety actions

2.50 On 26 June 2023, TfNSW issued TS 03961:1.0[13] *Bus Mounting and Installation of Electrical Equipment Standard*. This document was a first issue with the designation TS 03961 and superseded T BU FL 01701 ST *Mounting and Installation of Electrical Equipment*, version 1.0.

2.51 TS 03961:1.0 provided the requirements for the design, construction, mounting, cabling and installation of electrical equipment for buses procured, refurbished or modified on behalf of TfNSW.

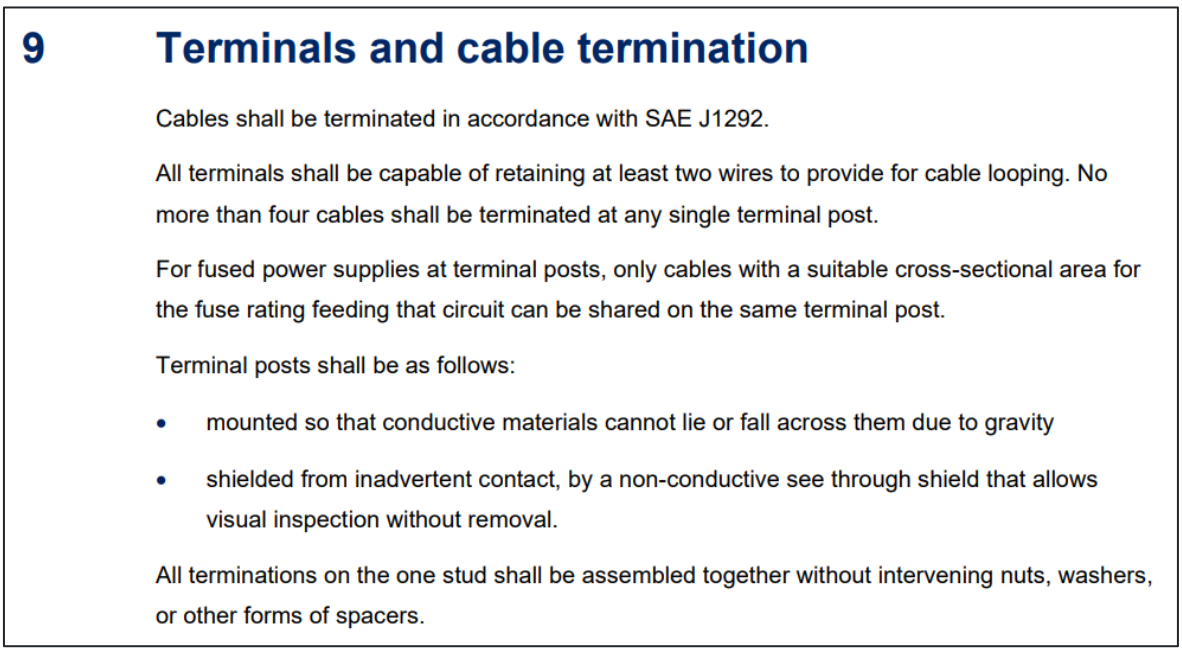
2.52 This document also provided the requirements for the construction, mounting and installation of electrical equipment on buses by setting out the principles, processes, and requirements that as a minimum need to be fulfilled.

2.53 TS 03961:1.0 documented several general constructional considerations for bus electrical systems including that 'all electrical equipment, circuits and systems shall be constructed and arranged so that it does suffer deterioration, wear or damage due to vibration or shock loads found in the vehicle's operating environment'.

2.54 Section 9 detailed requirements for terminals and cable termination (Figure 34).

[13] Version 1.0, effective date 26 June 2023

Figure 34: Excerpt from TfNSW TS 03961:1.0, Section 9 'Terminals and cable termination



9 Terminals and cable termination

Cables shall be terminated in accordance with SAE J1292.

All terminals shall be capable of retaining at least two wires to provide for cable looping. No more than four cables shall be terminated at any single terminal post.

For fused power supplies at terminal posts, only cables with a suitable cross-sectional area for the fuse rating feeding that circuit can be shared on the same terminal post.

Terminal posts shall be as follows:

- mounted so that conductive materials cannot lie or fall across them due to gravity
- shielded from inadvertent contact, by a non-conductive see through shield that allows visual inspection without removal.

All terminations on the one stud shall be assembled together without intervening nuts, washers, or other forms of spacers.

Source: Transport for NSW

2.55 This TfNSW Standard also contained several requirements related to battery isolation, including:

- a manually operated battery master switch shall be provided adjacent to the batteries to isolate power to the vehicle;
- a method of remote battery isolation control shall be provided on the driver's instrument panel; and
- operation of the remote isolation shall isolate all electrical circuits fed from the vehicle's batteries other than the bodyside hazard warning indicators which shall remain active.

2.56 As part of the Directly Involved Parties review process for the Draft Report, TfNSW advised that:

'TfNSW regularly reviews its asset management requirements around safety risk management to ensure they remain fit for purpose and identify opportunities to improve. The specific areas either in review or planned for review include:

- Opportunities to review and improve the asset handover, certification and acceptance process;
- Review of BOAS;
- Expansion of AMB Standards for buses;
- Review applicability of the Technical Assured Organisation (TAO) model for possible inclusion in the bus space;

2.57 TfNSW also advised that it could undertake a targeted inspection program, including a sample of Volvo B7RLE/Custom CB80 configuration, and a parallel inspection of sample model configurations. Following the findings from that process, TfNSW could then determine the requirement for a more widespread inspection of buses.

Part 3 — Findings

From the evidence available, the following findings are made with respect to the bus fire involving a 2016 Volvo B7R, registration MO9994, fitted with a Custom Bus Australia CB80 body, which occurred in Green Valley, NSW on 8 August 2022.

Contributory factors

3.1 An electrical fault in the Accessory Panel located above the driver's position resulted in fire.

3.2 The Accessory Panel electrical circuit was not adequately protected from over current faults, such as a short circuit, with the fuse protecting the circuit exceeding the ampacity of the associated cables, resulting in increased potential of fire.

3.3 Asset management processes, including configuration design, documentation, and installation assurance/inspection, did not effectively ensure that there were adequate circuit protections and systems isolation, to prevent escalation to fire, of an electrical fault in the involved bus.

Other safety factors

3.4 The bus operator did not provide the driver of MO9994 with a suitable level of recent practical training and competency assessment to assure effective management of the emergency situation, which likely resulted in the delayed evacuation of passengers after the detection of smoke in the saloon area.

3.5 The electrical circuit isolation design and configuration of the involved bus, and two exemplar buses, did not allow isolation of the Accessory Panel circuit, resulting in inadequate system protection from ongoing provision of a source of energy for the escalation and propagation of fire from an electrical short circuit in that location.

3.6 At the time of the incident, the battery isolation system limitations had not been identified by the bus chassis or body builder OEMs, TfNSW, or the bus operator. This resulted in incorrect reporting that the involved vehicle configuration was fitted with a battery isolator located in the battery box for complete isolation of all power to the vehicle as required.

3.7 The Transport for NSW Asset Management Framework did not effectively incorporate adequate risk control measures to assure that buses built and procured under Bus Panel specifications complied with the Original Equipment Manufacturers' responses to tender.

3.8 Without knowledge of the battery isolation limitations of the involved bus and exemplar buses, the bus operator's procedure to isolate power to the bus was ineffective in removing power from the bus body in an emergency. This system limitation would also be unknown to emergency services and vehicle recovery services who may use the battery isolation functionality as part of an emergency response.

3.9 Cessation of operations by the involved bus body Original Equipment Manufacturer compromised support for the continued operation and whole of life asset management of related existing assets.

Part 4 — Recommendations

Noting that some remedial safety action has already been implemented, it is recommended that the following additional safety actions be undertaken by the specified responsible entity.

Bus and coach operators

4.1 Review maintenance regimes to ensure inspections adequately address and remedy any issues with wiring integrity and security, including protection of live terminal posts and proximity to other conductive components.

4.2 Ensure that a practical, competency-based driver refresher training program for emergency procedures, with training documented and records maintained, is in place to provide drivers with an effective level of skills and knowledge to safely manage an emergency.

Transport for NSW

4.3 Review current asset management requirements to apply a more comprehensive safety risk management and regulatory framework for long-term asset management, and ensure required specifications are delivered by bus and coach manufacturers and installers for assets operating public passenger services.

4.4 Ensure provisions for the supply of documentation to bus operators and maintainers, including wiring schematics, for asset build and all pre- and post-delivery installations.

4.5 Ensure provisions for continued Original Equipment Manufacturer support for the life cycle of assets procured under the Transport for NSW Bus Procurement Panel program.

4.6 Develop and implement an inspection and rectification program to ensure electrical circuits on the current fleet of buses operating accredited Transport for NSW passenger services are adequately protected and can be effectively isolated as required.

Transit Systems NSW

4.7 Review emergency procedures and documentation, and driver training to ensure emergency procedures are relevant and reflect the configuration of individual buses, including isolation switch activations.

4.8 Develop and implement a practical, competency-based driver refresher training program for emergency procedures, with training documented and records maintained, to ensure that drivers are provided with an effective level of skills and knowledge to safely manage an emergency.

4.9 Develop and implement an inspection and rectification program to ensure electrical circuits on the Transit Systems NSW current fleet of buses are adequately protected and can be effectively isolated as required.

Volvo Bus Australia

4.10 Review technical assurance processes to ensure that assets built and delivered in accordance with Transport for NSW Bus Procurement Panel specifications comply with documented requirements.

Part 5 — Appendices

Appendix 1: Sources, submissions, and acknowledgements

Sources of information

- Transit Systems NSW
- Transport for NSW
- Volvo Bus Australia

References

Custom Bus Australia, *Metro CB CB80 Electrical Drawings*

Green Grid report, 2019, *Managing fuse protection in low-voltage networks with distributed generation*

Standards Australia, AS/NZS 3008.1.1:2017, *Electrical Installations-Selection of cables*

Standards Australia, AS/NZS 3000:2018, *Electrical installations*

Transport for NSW, TS 03961:1.0, *Bus Mounting and Installation of Electrical Equipment Standard*

Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Custom Bus Group
- Transit Systems NSW
- Transport for NSW
- Volvo Bus Australia

Submissions were received from the following DIP:

- Transport for NSW

The Chief Investigator considered the representations made by the DIP and responded to the author of the submission advising which of their recommended amendments would be incorporated in the final report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.

Office of Transport Safety Investigations

OTSI is an independent NSW authority which contributes to the safe operation of bus, ferry and rail passenger and rail freight services in NSW by investigating safety incidents and accidents and transport safety risks, identifying system-wide safety issues, and sharing lessons with transport operators, regulators and other stakeholders.

OTSI is empowered under the *Transport Administration Act 1988* to investigate rail, bus, and ferry accidents and incidents in accordance with the provisions of the *Passenger Transport Act 1990* and *Marine Safety Act 1998*. It also conducts rail investigations on behalf of the Australian Transport Safety Bureau. This is part of a collaboration agreement between the two agencies. These investigations are conducted under the *Transport Safety Investigation Act 2003* (Cth).

OTSI investigations are independent of regulatory, operator or other external entities. OTSI investigates using a 'no-blame' approach to understand why an occurrence took place and to identify safety factors that are associated with an accident and incident, to make recommendations or highlight actions that transport operators, regulators and government can take to prevent recurrence and improve safety.

Evidence obtained through an OTSI investigation cannot be used in any subsequent criminal or disciplinary action. However, a regulator can undertake its own investigation into an incident OTSI has investigated and coronial inquiries can obtain access to OTSI information.

OTSI does not investigate all transport safety incidents and accidents but focuses its resources on those investigations considered most likely to enhance bus, ferry or rail safety. Many accidents result from individual human or technical errors which do not involve safety systems so investigating these in detail may not be justified. In such cases, OTSI will not generally attend the scene, conduct an in-depth investigation, or produce an extensive report.

OTSI may request additional information from operators or review their investigation reports which may lead to a number of actions, such as the release of a Safety Advisory or Alert to raise industry awareness of safety issues and action.

OTSI investigators normally seek to obtain information cooperatively when conducting an investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to conduct interviews, enter premises and examine and retain physical and documentary evidence.

Publication of the investigation report

OTSI produces a written report on every investigation for the Minister for Transport, as required under section 46BBA of the *Passenger Transport Act 1990*.

Investigation reports strive to reflect OTSI's balanced approach to the investigation, explaining what happened and why in a fair and unbiased manner. All Directly Involved Parties will be given the opportunity to comment on the draft investigation report.

The final investigation report will be provided to the Minister for tabling in both Houses of the NSW Parliament in accordance with section 46D of the *Passenger Transport Act 1990*. The Minister is required to table the report within seven days of receiving it.

Following tabling, the report is published on the OTSI website — www.otsi.nsw.gov.au — and information on the safety lessons promoted to relevant stakeholders.

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