RAIB
Rail Accident Investigation Branch

# Rail Accident Report

## Fire on prototype tram 611 at Blackpool 24 January 2007

Department for Transport

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This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- the Railways (Accident Investigation and Reporting) Regulations 2005.



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## Introduction

1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.

2 The RAIB does not establish blame, liability or carry out prosecutions.

3 Access was freely given by Blackpool Transport Services (BTS), Trampower and Her Majesty's Railway Inspectorate (HMRI) to their staff, data and records in connection with the investigation.

4 Technical terms (shown in *italics* the first time they appear in the report) are explained in Appendix A.

## Summary

### Key Facts about the incident

5 On 24 January 2007 at approximately 16:15 hrs, tram 611, a prototype City Class tram, was stationary near Foxhall Square in Blackpool when a fire occurred inside the vehicle near the front (B end) driving position. There were no casualties. The cause of the fire has not been conclusively determined. Figure 1 shows the location of the incident.

6 Because of the nature of the fire and because the tram was running under test conditions without passengers, the RAIB investigation focussed on determining the design and operating control measures that were in place and those that would have been needed to prevent the incident.

7 The RAIB has made two recommendations, one with regard to the safety management procedures of Blackpool Transport Services (BTS) and another with regard to the design, construction and provision of relevant documentation for the tram by Trampower Ltd.

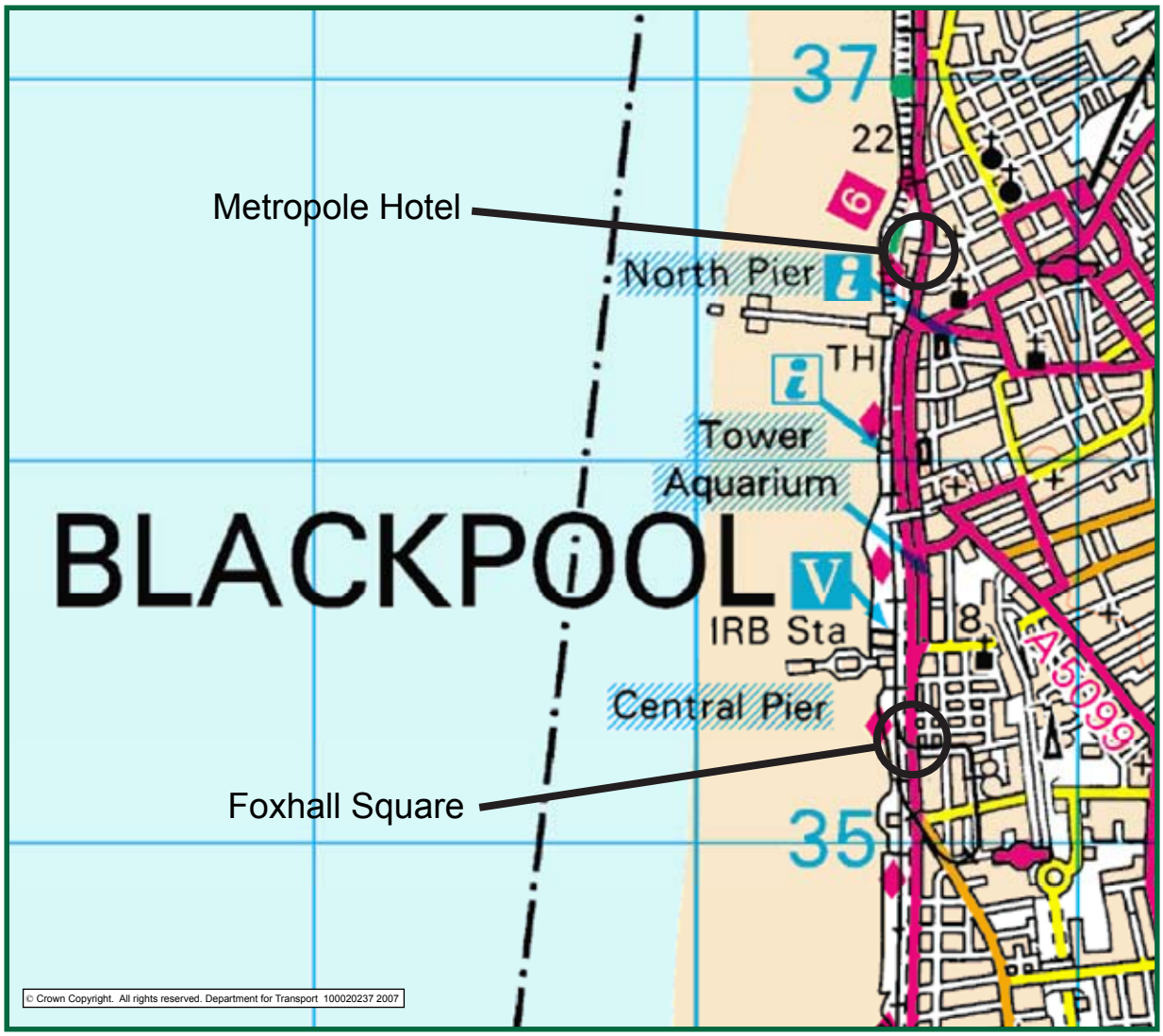


*Figure 1: Extract from Ordnance Survey map showing the location of the incident*

## The fire

8 Tram 611 is a prototype vehicle owned and developed by Trampower Ltd. It was being tested on the Blackpool tramway system and was returning to the depot after completing the test running programme for that day. The driver was operating the tram from the B end. The tram was not approved for, and the testing did not include, the carriage of passengers. The tram is shown in figure 2.

9 During its journey towards the depot the tram had been stationary near to Cocker Street, north of the Metropole Hotel, for 15 minutes. The driver had been waiting for permission to proceed and during this time he had been completing his records for the day's work.

10 The tram then continued southwards, reaching a maximum speed of 33 km/h and taking seven minutes to travel to a point near to Foxhall Square (see Figure 1). The driver applied the brakes of the tram, in preparation for crossing over at the points towards the depot.

11 The driver smelled burning and then observed smoke permeating from the panels to the right-hand side of the driving position at the B end of the vehicle. The driver released his hold on the traction/brake controller and the tram stopped, as designed. The driver investigated the problem and he observed smoke and flames to the rear of the driving position, emanating through a ventilation grille from under the first rearward facing passenger seat. The driver evacuated the vehicle through the B end driver's door. In his haste to leave the vehicle, the driver did not lower the pantograph or remove the driver's key.

12 Once outside the vehicle, the driver realised that he had not lowered the pantograph as required in an emergency. The driver then went to the rear of the tram and opened the A end driver's door. He realised that he would not be able to lower the pantograph from this position as the control panel could not be enabled without the use of the driver's key. He could not retrieve the key as the fire at the B end was by then too intense. The driver was unable to enter the passenger saloon from the A end and lower the pantograph manually, due the presence of smoke. Figure 3 shows the tram during the fire.

13 The Fire and Rescue Service were called by a passing paramedic and attended at 16:20 hrs. At the same time the driver telephoned the tramway depot to obtain an isolation of the overhead traction power supply and this was isolated at 16:23 hrs. The fire was brought under control and extinguished by 16:29 hrs and the tram was subsequently towed into the depot.

*Figure 2: Trampower City Class tram*

## Cause of the fire

14 BTS notified the incident to the RAIB immediately. The information contained in the initial notification confirmed that this was a Schedule 2 event, as defined in the Railway (Accident Investigation and Reporting) Regulations (2005). Thereafter BTS provided RAIB with regular updates of the situation. On the basis of the information provided the RAIB did not make an immediate deployment.

15 Subsequently, information became available which indicated that the scale of the fire was greater than originally perceived and the RAIB decided to carry out an investigation.

*Figure 3: Tram 611 during the fire (courtesy of Blackpool Transport Services Ltd)*

16 The RAIB carried out an inspection of the tram on Monday 29 January. The interior seating and panels, control and power equipment and external glazing and cladding of the tram sustained significant damage at the B end due to the fire. The remainder of the vehicle was damaged by smoke. Figure 4 and Figure 5 show details of the fire damage.

*Figure 4: Fire damage to the exterior at the B end*


*Figure 5: Fire damage to the B end driving position*

17 In the period following the fire, and before the RAIB inspection, the vehicle had been inspected by others, including a forensic fire specialist on behalf of the insurers, and some evidence had been disturbed.

18 The RAIB examination of the tram indicated that the seat of the fire was in an under-floor compartment below the first, rearward facing, passenger seat behind and to the right-hand side of the B end driving position. This compartment is constructed of plywood and houses both low and high voltage electrical equipment including rheostatic brake resistors. The air to cool this compartment is drawn from a central channel that houses the traction motor.

19 There was no evidence of a defect or failure within the high voltage power control system. The low voltage wiring in the underfloor compartment was severely damaged and a conclusive analysis was not possible. It is probable that the fire began within the low voltage electrical system. This view is shared by the forensic fire specialist.

20 It has also not been possible to accurately determine how long the fire had been burning before being noticed by the driver.

21 The condition of the wiring and equipment installation was not to a standard that would be acceptable for a tram carrying passengers.

22 There was no evidence that the tram driving technique or the infrastructure contributed to the incident.

# The Investigation

## The testing of tram 611

23 BTS was given consent by Her Majesty's Railway Inspectorate (HMRI) under *The Railway and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994* (ROTS) to trial the prototype City Class tram on 22 February 2006, for a second period of six months.

24 The letter giving consent states that this is 'for the purposes of obtaining information to prove their satisfactory performance in connection with an application for an approval'. The consent is given 'provided that the testing and trials are conducted in accordance with the terms of such consent'. The granting of consent for this type of trial does not require design or construction to be compliant with prescriptive standards. This confirms that the trials were permitted before formal ROTS approval was sought or obtained. The RAIB report into the derailment of tram 611 at Starr Gate on 30 May 2006 (RAIB report number 15/2007) gives more information about the process of giving consent for it to run.

25 The letter giving consent also states that any passenger trials require further consent and that this would be conditional upon presentation of a suitable risk assessment based upon the results of the initial tests. It was Trampower's belief that at the end of the period of test running, estimated to be mid February 2007, an application would be made to HMRI for passenger running.

26 As a pre-approval test prototype, it was the HMRI view that the tram did not need to meet all of the requirements that would be required of an approved passenger-carrying production vehicle (paragraph 24). However, construction should be to an acceptable standard. The constructor of the vehicle, Trampower Ltd, had previously assured HMRI that the wiring of this prototype would be in accordance with BS 7671:2001 Requirements for Electrical Installations (IEE Wiring Regulations).

27 Although HMRI hold regular liaison with BTS in connection with the tram system operation, they are not under legislation obliged to and did not carry out any specific checks into the construction of this vehicle, the conduct of the trials or the safety provisions for them. The responsibility for specifying, arranging and conducting the trials lay with the operator, BTS.

28 Maintenance of the tram was managed by Trampower Ltd. BTS provided some resource to assist with fault-finding and wiring alterations. BTS were provided with a wiring diagram issued in 2004 and a control system schematic. A number of changes had been made to the wiring since 2004. BTS operated a fault reporting system to ensure that any defects, which were identified during test running, were corrected and closed out.

29 BTS had developed test programmes for the trials jointly with Trampower Ltd. These simulated service running conditions and event data from the tram system was captured by an on-board recorder. There was also a series of bullet-point checks to be carried out by the driver, both before and during the test running.

30 BTS were unable to produce any documented risk assessment for the acceptance or use of this vehicle.

31 HMRI was aware that trials were ongoing beyond the end date of October 2006, but did not intervene.

## Risk assessment and Safety Management Systems

32 Section 2 of The Health and Safety at Work etc Act 1974 (HASAWA) requires all employers to ensure, so far as is reasonably practicable, the health, safety and welfare at work of their employees whilst at work. The risks to others not in their employ are to be ensured under section 3 of HASAWA. This is the fundamental basis of United Kingdom health and safety law and is applicable to the operation of BTS.

33 The Management of Health and Safety at Work Regulations 1992 require that every employer shall make a suitable and sufficient assessment of (a) the risks to the health and safety of his employees to which they are exposed whilst they are at work; and (b) the risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him of his undertaking,

34 *The Railway and Other Guided Transport Systems (Safety) Regulations* (ROGS) came into force on 10 April 2006. The provisions of these Regulations apply to tramway operators. However, tramways can opt to continue their operations under the previous regulatory requirement, ROTS, until 2010, except that they must establish and maintain a Safety Management System (SMS) as mandated by ROGS from 31 March 2007. Regulation 6 of ROGS details the requirement for an SMS to ensure 'the control of all categories of risk associated with the operation…' and 6 (c) (iii) covers '….placing in service of new or altered vehicles…..capable of significantly increasing an existing risk or creating a significant safety risk'. The testing of tram 611 did not constitute placing in service.

35 At the time of the incident BTS had not finalised or implemented their formal SMS to comply with the requirements of ROGS from 31 March 2007.

36 Before new tramway vehicles are placed into passenger carrying operation, they must be granted approval as defined in the ROTS Regulations or ROGS Regulations as selected at the time by the tramway. The ROTS approval process is under the control of HMRI. The ROGS approval process uses competent bodies to provide an independent assessment. Both processes assess vehicles for a range of parameters and against applicable standards, including design and construction, and also consider the results of any testing or trials.

37 The future of ROTS and potential mandated application of ROGS in its entirety to tramways is under discussion between HMRI and UK Tram, the trade body for light rail in the United Kingdom.

38 BTS regularly operate vehicles which are not owned by them and are loaned to them for a period of operation. BTS do have a management procedure for the assessment of imported heritage type vehicles which are of a generically similar type to their own fleet. However, this was not appropriate for and was not used in the case of tram 611. Many vehicles which fall into similar operational circumstances are moved from network to network and these are not specifically checked by HMRI. This applies to loan and hire vehicles at many heritage tram and rail operations.

## Response of the emergency services and others

39 The Fire and Rescue Service attended within five minutes of the fire being identified and the fire was brought under control in a further nine minutes. The isolation of the overhead traction supply was provided within three minutes of the request being made.

## Conclusions

40 The fire probably occurred because of a fault in the low voltage electrical system of the tram. The condition of the wiring and the equipment installation was not to a standard that would be acceptable for a tram carrying passengers.

41 BTS did not carry out a risk assessment for the operation of this vehicle, which would have identified and adequately mitigated the risks to their employees and others, and in particular did not carry out any assessment of the risk from fire. No information appropriate to the conduct of such a risk assessment was provided to BTS (**Recommendation 2**).

42 BTS did not develop any specific emergency arrangements relating to the testing of tram 611.

43 BTS did have safety management procedures, but these did not adequately cover the introduction of vehicles based upon new technology. They have subsequently developed a formal Safety Management System which includes the management of change ie the introduction of new vehicles (**Recommendation 1**).

## Recommendations

44 The following recommendations are made[1]:

1. Blackpool Transport Services should develop vehicle acceptance procedures and integrate these into the "management of change" procedure within the Safety Management System (paragraph 43).

2. Trampower Ltd should carry out an appropriate risk assessment relating to the design, construction and operation of the vehicle with reference to Regulation 3 of the Management of Health and Safety at Work Regulations. Part of this assessment should consider whether components and systems are appropriately constructed and installed in a way that is fit for their intended use. This risk assessment, and related currently-applicable technical documentation, should be provided to the operators of any network where the vehicle is used (paragraph 41).

[1] Responsibilities in respect of these recommendations are set out in the Railways (Accident Investigation and Reporting) Regulations 2005 and the accompanying guidance notes, which can be found on RAIB's web site at www.raib.gov.uk

## Glossary of terms

## Appendix A

All definitions marked with an asterisk, thus (*), have been taken from Ellis' British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com

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| Railway and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994 (ROTS) | Regulations which require approval to be obtained before any new or altered works, plant or equipment (which are capable of affecting the safe operation of a relevant transport system) are first brought in to use.* |
| Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS, ROGTS) | A single piece of legislation which replaces and unifies the following legislation:<br>● The Railway and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994 (ROTS)<br>● The Railway (Safety Critical Work) Regulations 1994 (RSCWR and R(SCW)) The Railway (Safety Cases) Regulations 2000 (RSCR).* |

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