



## **Investigation Report 2010-R002**



**Derailment of LUAS tram at Connolly Station,**

**LUAS Red Line, Dublin City**

**16<sup>th</sup> of July 2009**

**Document History**

<b>Title</b>	Derailment of LUAS tram at Connolly Station on the 16 <sup>th</sup> July 2009
<b>Document type</b>	Investigation Report
<b>Document number</b>	2010-R002
<b>Document issue date</b>	21/04/2010

<b>Revision number</b>	<b>Revision date</b>	<b>Summary of changes</b>

## **Function of the Railway Accident Investigation Unit**

The Railway Accident Investigation Unit (RAIU) is a functionally independent investigation unit within the Railway Safety Commission (RSC). The purpose of an investigation by the RAIU is to improve railway safety by establishing, in so far as possible, the cause or causes of an accident or incident with a view to making recommendations for the avoidance of accidents in the future, or otherwise for the improvement of railway safety. It is not the purpose of an investigation to attribute blame or liability.

The RAIU's investigations are carried out in accordance with the Railway Safety Act 2005 and European railway safety directive 2004/49/EC.

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## **Executive Summary**

On Thursday the 16<sup>th</sup> of July at 15.57 hours, the driver took over the LUAS red line Tram 3006 at Tallaght (South County Dublin) and drove to Connolly (North Dublin City Centre). At approximately 17.10 hours the driver changed cabs at Connolly Station, and exited on the normal outbound route towards Tallaght with passengers on board.

Whilst travelling outbound, the tram travelled past the Points Position Indicator for the facing points and over the points when the driver heard a loud bang and stopped the tram. This loud bang was as a result of the second wheelset of the first bogie derailing and rerailling.

Two off-duty Veolia staff were present at Connolly and checked the tram not noticing any sign of derailment, however, they did notice an item of clothing under the tram. The driver then continued a short distance before stopping when seeing the driving cab was swerving towards the wall, due to the second wheelset travelling in the diverging direction.

The investigation found that the Points Position Indicator for the points was displaying a single dot aspect prior to the driver exiting Connolly, meaning the facing points were not properly set for the normal outbound route. The points not being set for the route was a result of an item of clothing being stuck in the points.

After reviewing the factual information and carrying out the analysis into the accident the RAIU has concluded that the driver was experienced, did not appear to be effected by the late running of the service, and there were no distractions present. Therefore, the driver not checking the PPI was a human error omission.

## **Immediate cause and contributory factor resulting in this accident**

The immediate cause of the accident:

- The tram driver did not react to the 'position of the points not detected' indication on the PPI sited on the approach to points SO-9D at Connolly Station, and proceeded over the points causing the tram to derail.

A contributory factor was:

- The points did not return to normal after the passage of the tram into the outbound platform as there was an item of clothing stuck in facing points SO-9D.

## **Recommendations**

The findings of this investigation, combined with the actions already taken by Veolia, result in this investigation not sustaining any recommendations.

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## 1 Factual information

### 1.1 Parties involved

Veolia Transport Ireland operates the LUAS, Dublin's light rail tram system on behalf of Railway Procurement Agency (RPA<sup>1</sup>), the government agency with responsibility for LUAS. Veolia Transport employs the tram drivers and controllers.

The RPA awarded the infrastructure maintenance contract for the LUAS to Alstom Transport.

### 1.2 The accident

On Thursday the 16<sup>th</sup> of July at 15.57 hours (hrs), the driver took over the LUAS red line Tram 3006, service number 17, at Tallaght (South County Dublin) and drove to Connolly (North Dublin City Centre). At approximately 17.10 hrs, exited Connolly Station *outbound* towards Tallaght Station with passengers on board.

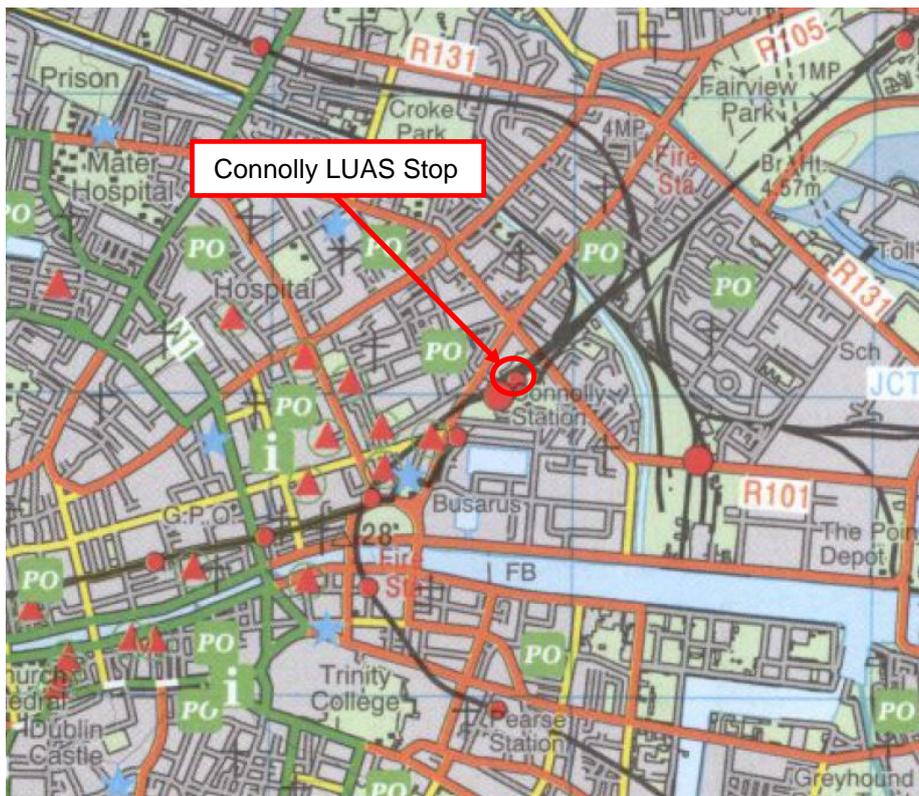


Figure 1 – Location Map of Dublin City

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<sup>1</sup> Abbreviations and acronyms are included in the 'Glossary of abbreviations and acronyms' section of this report.

Whilst travelling outbound, in the *normal* direction (the green route indicated in Photo 1), the tram travelled 26 metres (m), past the *Points Position Indicator*<sup>2</sup> (PPI) for *facing points* SO-9D and over the points when the driver heard a loud bang and stopped the tram. Two off-duty Veolia staff were present at the scene and checked the tram, not noticing any sign of derailment, however they did notice what appeared to be an item of clothing under the tram. The driver then continued a further 10m before stopping when seeing the driving cab was moving towards the wall.



Photo 1 – View from Connolly Tram Stop

The tram stopped with the first *bogie* on the outbound route (green route) and the second bogie on the *inbound / reverse* route (red route).

The driver contacted *Central Control Room (CCR)* to inform them there was a problem with the tram leaving Connolly. The driver then evacuated the passengers from the rear of the tram onto Connolly Station. There were no injuries resulting from this accident. The accident occurred during daylight hours. The weather was dry with good visibility. The final position of the tram is illustrated below in Figure 2.

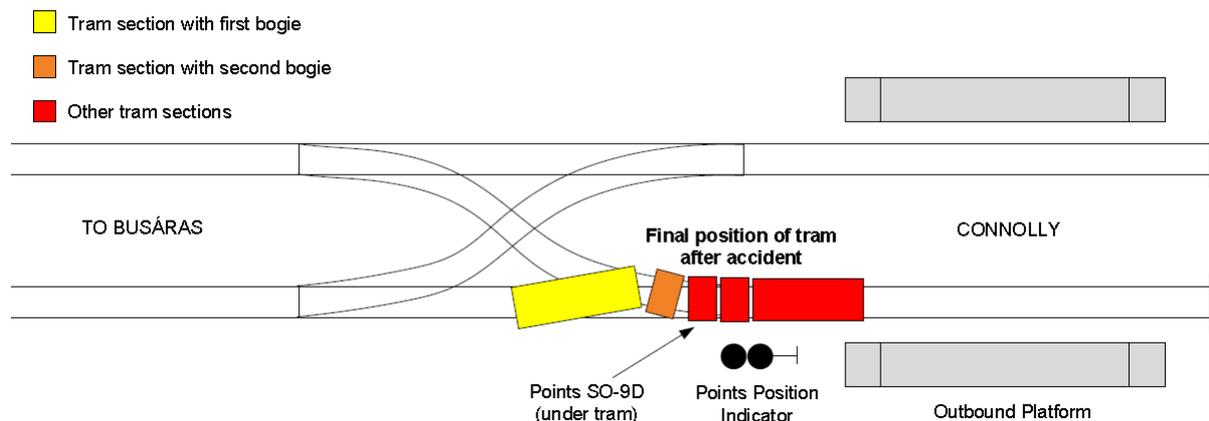


Figure 2 – Final position of the tram after accident

<sup>2</sup> Some technical terms, which appear in the document for the first time in italics, are included in the 'Glossary of terms' section of this report

### 1.3 Track and points at Connolly Station

#### 1.3.1 Track

The track layout at Connolly Station consists of a *scissor crossover* in *grooved rail* laid in a printed concrete embedded structure.

#### 1.3.2 SO-9D points layout

SO-9D are the fitted at the exit of the outbound platform at Connolly Station. The points are set in either *normal* or *reverse* positions. The points are spring actuated which means the points return to the normal position, outbound from Connolly (along the wall). The points are also fitted with a PPI before the points, which displays, to the driver, the status of the points. Figure 3 illustrates the layout of SO-9D points.

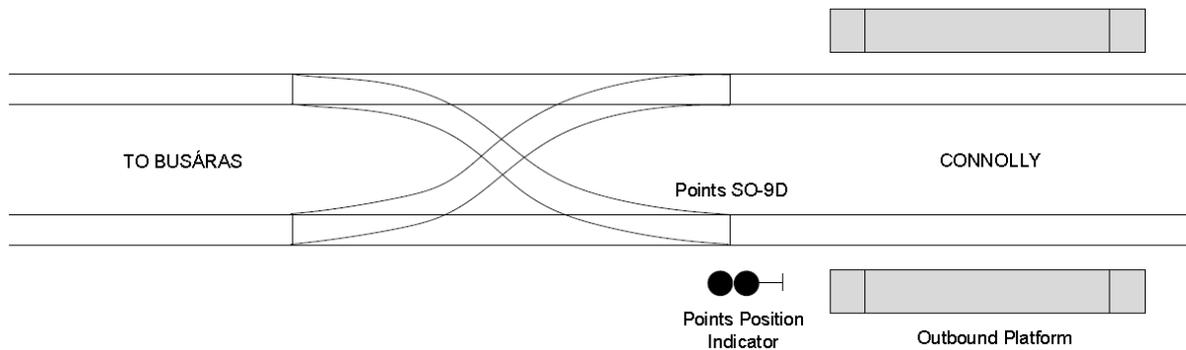


Figure 3 – SO-9D points layout

#### 1.3.3 Inspection and maintenance of points

There are a number of routine tests, inspections and maintenance regimes in place for facing points. These tests and inspections are listed below along with the frequency:

Test/ Inspection	Frequency
Switch Inspection & Lubrication	Weekly intervals
Facing points test	Monthly intervals
Detailed Track Inspection	Three monthly intervals
Switch & Crossing Maintenance Inspection	Six monthly intervals

A facing points test was carried out on SO-9D points on the 12<sup>th</sup> of July, four days before the accident, and no issues were found. Maintenance and inspections were not found to have contributed to this accident.

## 1.4 Operations and communications

This tram is worked by a tram driver, who observes the road and tramway traffic in front and controls the speed of their tram appropriately to maintain a safe distance between them. This is known as *line-of-sight* driving. Independent tram signals are used to give indications to the tram driver to control movements.

In normal operation the *inbound* trams arrive at the *outbound* platform, unless already occupied, in which case they arrive on the inbound platform. From Connolly platform, the driver does not need to select the route as the points are spring actuated and in the normal position. The driver needs to check the PPI to confirm that the route is selected before exiting.

The communication between the driver and CCR is through an in-cab radio. Connolly Station stop has closed-circuit television (CCTV) coverage, the tram also has onboard CCTV coverage.

## 1.5 Signalling

### 1.5.1 Points Position Indicator signals

The signalling system on the LUAS line is through the use of PPI signals. Photo 2 and 3 of the aspects at SO-9D, relevant to this accident, are illustrated below:



Photo 2 – Points set to the left



Photo 3 – Position of the points not detected

The 'Tramway Safety Instruction Manual'<sup>3</sup> states that when the 'points set to the left' aspect is showing, the driver can proceed in left direction if safe to do so, as this confirms to the driver that the route has been set. If the 'position of the points not detected' aspect (also known as the single dot aspect) is indicated the driver must stop, contact CCR for further instruction. The manual also states that for the single dot aspect there is a danger of derailment and a visual check of the points is required.

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<sup>3</sup> Tramway Safety Instruction Manual, Veolia Transport Dublin Light Rail Ltd, Revision 05/10/2007

### **1.5.2 Veolia data file**

Veolia records the movements of the points on a system known as the *Depot Control System (DCS)*. For normal movements through the points the DCS records the sequence of opening and closing of the points for each bogie passing through the points. If the points do not close and remain open for more than 30 seconds a failure is recorded on the DCS.

The download from the time of the accident indicates that the points did not close when the tram went into the outbound platform, therefore this suggests that the PPI was displaying a single dot aspect at the time the tram exited Connolly Station Platform.

### **1.6 Traction and rolling stock units**

Citadis Tram 3006, manufactured by Alstom, is a 40m five-section articulated doubled-ended *cab* unit. The tram had a valid pre-service check. The wheel profile was checked following the derailment which was found to be in accordance with the specification. The condition of the tram was found not to have contributed to the accident.

### **1.7 Driver training and competency**

The tram driver had over three years experience of tram driving at the time of the derailment. In accordance with normal procedures, the driver was tested for drugs and alcohol following the accident, with negative results. The records relating to the driver's training, assessment, and monitoring were examined as part of the investigation. No factors relevant to training or assessment were found to have contributed to the accident.

### **1.8 Fatalities, injuries and material damage**

#### **1.8.1 Fatalities and injuries**

There were no fatalities or injuries to the train driver or passengers as a result of the derailment.

#### **1.8.2 Infrastructure damage**

The points were damaged as a result of the derailment resulting in the replacement of some components of the points.

#### **1.8.3 Traction and rolling stock unit damage**

There was no damage to the rolling stock.

### **1.9 History of accidents/incidents**

There have been no similar accidents or incidents.

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## 2 Analysis

### 2.1 The accident

The RAIU has analysed the physical evidence at the site, documentary evidence produced and witness interviews to establish the sequence of the accident.

The tram driver drove into Connolly station and terminated on the outbound platform and then changed cab ends (Figure 4). The driver boarded passengers. The driver stated that he visually checked the points but cannot recall whether he checked the PPI aspect. The driver exited the outbound platform with a single dot aspect, showing 'position of points not detected'.

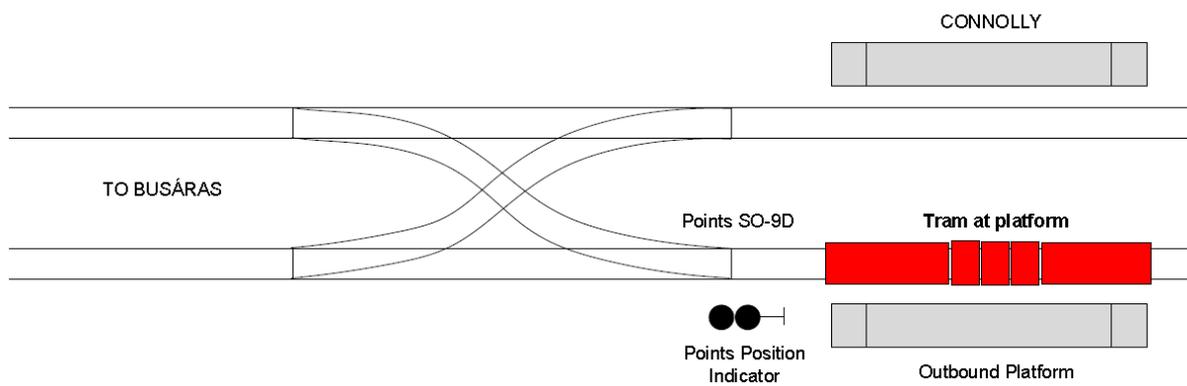


Figure 4 – Tram standing at outbound platform

The tram exited the platform outbound for Tallaght. The wheelmarks on the concrete, and concrete dust on the second *wheelset* of the first bogie, indicates that this is the wheelset derailed (Figure 5); and re-railed (Figure 6) as a result of the dragging force of the first bogie. This re-railment caused a loud bang, which the tram driver hears and as a result stops the tram.

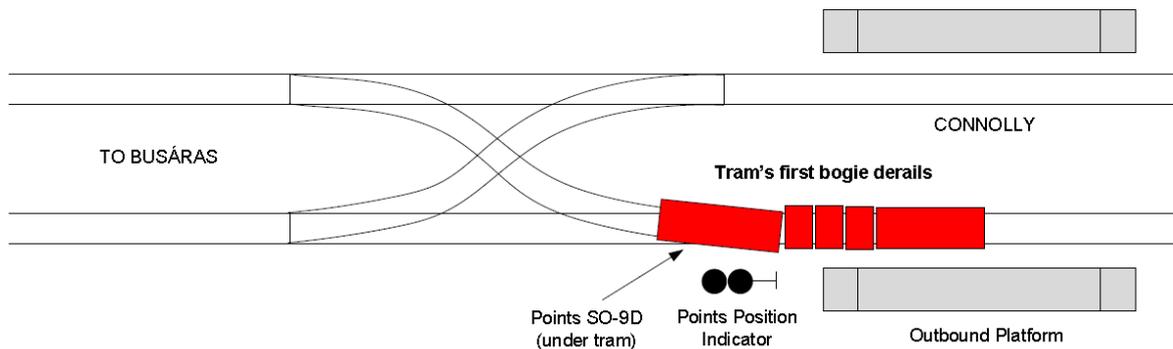


Figure 5 – First bogie derails

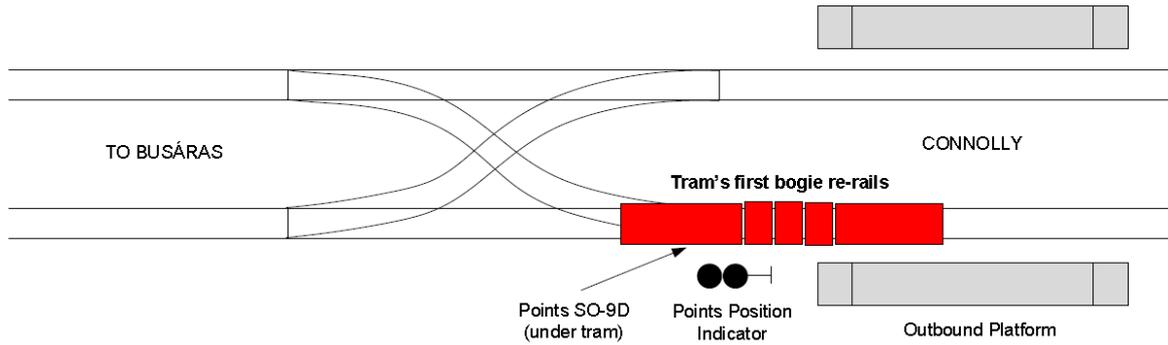


Figure 6 – First bogie re-rails

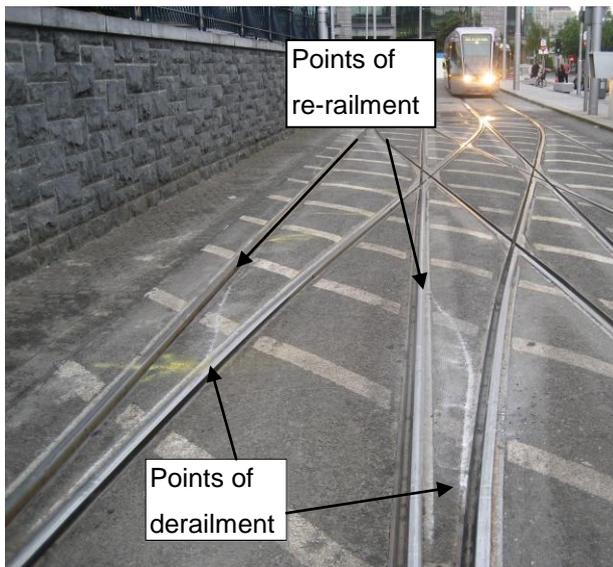


Photo 4 – Derailment marks (from Connolly)

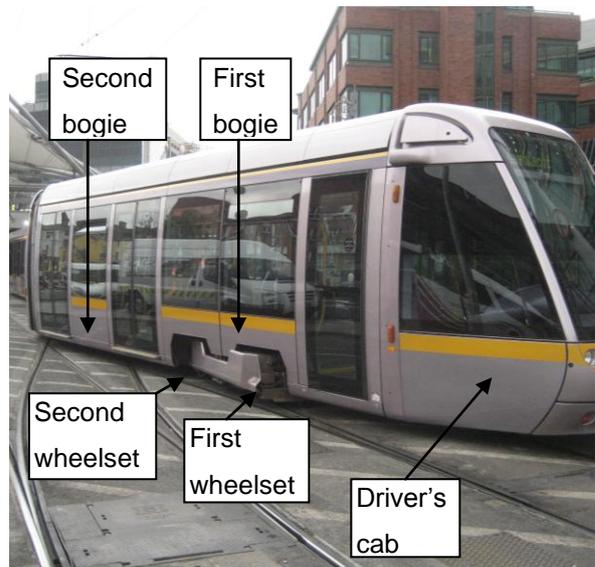


Photo 5 – Bogies and axles

Two off-duty Veolia staff were present at Connolly and checked the tram, not noticing any sign of derailment, however they did notice what appeared to be an item of clothing under the tram. The driver then continued a further 10m before stopping when seeing the driving cab was swerving towards the wall, as the second wheelset travelled in the diverging direction.

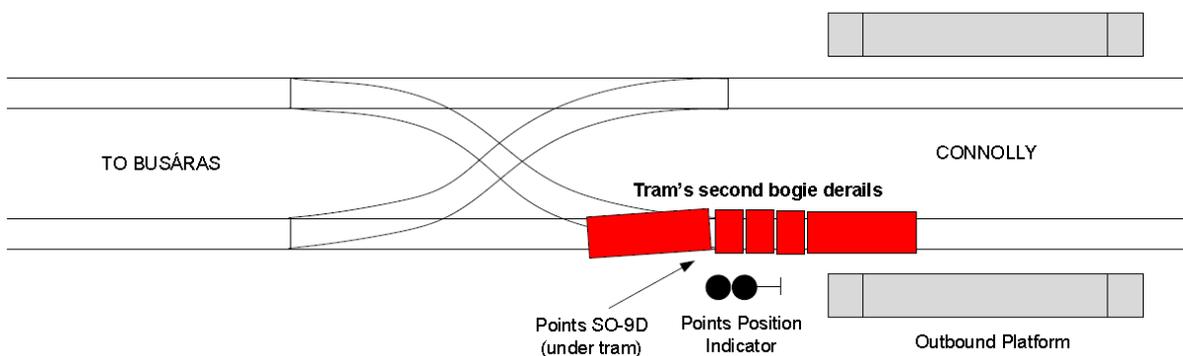


Figure 7 – Second bogie travelling in wrong direction.

## 2.2 Points SO-9D

From the download of information from the DCS file it was established that the points were showing a 'position error' alert, indicating that the points were not detected in either the normal or reverse position, suggesting they had been stuck in a position between the two.

On examination of the points after the derailment it was found that there was an item of clothing trapped in the points, shown in Photo 6.



Photo 6 – Clothing trapped in the points

The RAIU examined several hours of CCTV footage of the points leading up to the accident. It was found that no individual had inserted the item of clothing into the points. From the CCTV it is not conclusive whether or not the item of clothing was in the points prior to the driver exiting the station.

## 2.3 The tram driver

The driver came on duty at 15.49 on Thursday the 16<sup>th</sup> of July, took over the tram at 15.57 at Tallaght and drove to Connolly. This was the third day of his shift cycle, with his last rest day being Monday the 13<sup>th</sup> of July. The driver stated that he was rested prior to his shift.

The tram driver had encountered indications of 'position of points not detected' but this was less frequent in comparison to the number of times that the PPI displayed the correct aspect. However, the driver was aware of the instruction to contact CCR on single a single dot aspect. The safety file for the driver shows the correct understanding of this rule. It also shows that the driver has, in the past, reported previous PPI single dot aspects.

From the CCTV footage it can be seen that there are passengers on board. There were no passengers standing close to the *partition door* and there were no passengers or pedestrians trying to gain the drivers attention. The driver would have heard a certain amount of noise coming from the passengers, however this would be normal.

The tram service was running seven minutes late due to a slow tram on the line. Due to this late service the driver was under a time constraint, however, from the CCTV footage it was seen that it took the driver 98 seconds to change cab, therefore this driver time constraint is not seen to be contributory to the accident.

### **3 Relevant actions already taken or in progress**

Veolia have carried out an investigation into the cause of the accident which the RAIU has reviewed. The tram driver involved in the accident has been retrained.

### **4 Conclusions**

After reviewing the factual information and carrying out the analysis into the accident the RAIU has concluded that the driver was experienced, did not appear to be effected by the late running of the service, and there were no distractions present. Therefore, the driver not checking the PPI was a human error omission.

The DCS download from the time of the accident indicates that the points did not close when the tram went into the outbound platform, suggesting the PPI was displaying a single dot aspect when the tram exited Connolly Station Platform, this also suggests that the item of clothing was on the points prior to the tram exiting the outbound platform.

As a result of these factors the immediate cause and contributory factor to this accident can be summarised as the following:

The immediate cause of the accident:

- The tram driver did not react to the 'position of the points not detected' indication on the PPI sited on the approach to points SO-9D at Connolly Station, and proceeded over the points causing the tram to derail.

A contributory factor was:

- The points did not return to normal after the passage of the tram into the outbound platform as there was an item of clothing stuck in facing points SO-9D.

The findings of this investigation, combined with the actions already taken by Veolia, result in this investigation not sustaining any recommendation.

### **5 Recommendations**

This investigation does not sustain any safety recommendations.

## 6 Additional information

### 6.1 List of abbreviations and acronyms

CCR	Central Control Room
DCS	Depot Control System
hrs	Hours
m	Metre
PPI	Points Position Indicator
RPA	Railway Procurement Agency

### 6.2 Glossary of terms

Bogie	A metal frame equipped with two or three wheelsets able to rotate freely in plan.
Cab	A term for the driving cab, which is the driver's compartment in a tram.
CCR	Place from which tram operations are managed and monitored.
Depot Control System	A system that records operational data on the LUAS, for example, the position of points.
Facing points	A set of points installed so that traffic travels from switch toe to switch heel in the normal direction of traffic.
Grooved Rail	A type of flat bottom rail that has an integral check rail, they are used when the track is to be built as part of a roadway.
Inbound	Trams travelling towards the city.
Line-of-sight	A method of working trams where the driver observes the tram in front and controls the speed of their tram appropriately to maintain a safe distance between them, this also allows for the control of speed for road vehicles.
Normal	For a set of points, this is the default position, decided generally as the position which permits the passage of trams on the most used route.
Outbound	Trams travelling away from city.
Partition door	Door separating the driver's cab from the passenger compartment.
Platform/ Stop	Designated place for passengers to board and alight the tram.
PPI	Indication to driver for the position of points.
Reverse	For a set of points this is the 'wrong' position, allowing the passage of trams on the least used route.
Scissor crossover	Two intersecting opposite crossovers allowing movements in any direction between two parallel tracks
Wheelset	Two rail wheels mounted on their joining axle

