

Managing Overhead Line (OLE) on Network Rail's Wales & Western region



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Presentation overview

- Welcome and Introductions
- Background to Electrification on Wales & Western
- Description of the different OLE systems in use
- The railway as a system
- Pantograph types in use on Wales and Western
- OLE Maintenance
- What can go wrong?
- Pantograph Monitoring Systems
- Q&A



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Background to Electrification on Wales & Western



Great Western Electrification Program - Background

In 1998 an airport link called Heathrow Express was formed between Heathrow airport and London Paddington operated by Heathrow Express Operating Company.

Network Rails' plan in CP5 was to create faster, more reliable services, better stations and increased freight capacity by electrifying one of Britain's oldest and busiest railways.

As a result, this was the biggest investment in the Great Western railway since Brunel built it more than 150 years ago.

Modernising the route would:

- improve the experience of everyone who uses by improving connections across southern England and South Wales: London and Bristol, including Cardiff, Newbury and Oxford.
- stimulate economic growth in the South West and beyond;
- providing greener, more reliable journeys

Fleet change

Under the Intercity Express Programme (IEP), circa 57 electric Class 800 series trains were ordered as replacements for the ageing InterCity 125 diesels.

In May 2016, owing to delays in the modernisation project, it was confirmed that the new trains would be converted to 'bi-mode', meaning they can run on diesel fuel and electric overhead wire.



- ## Other routes

-



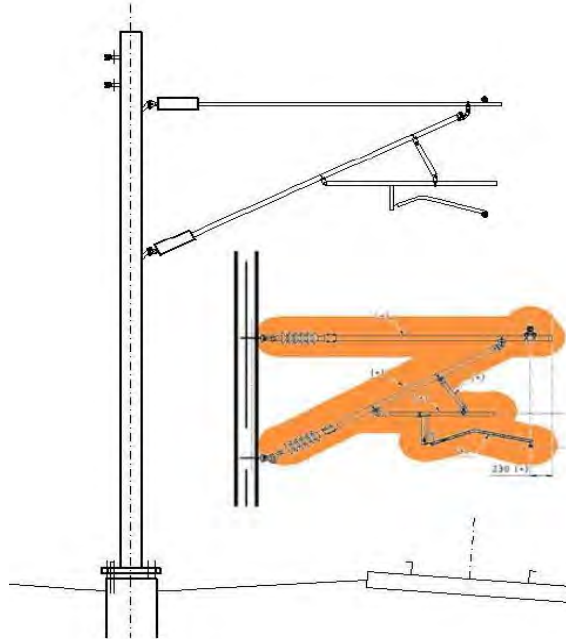
Description of the different OLE systems in use



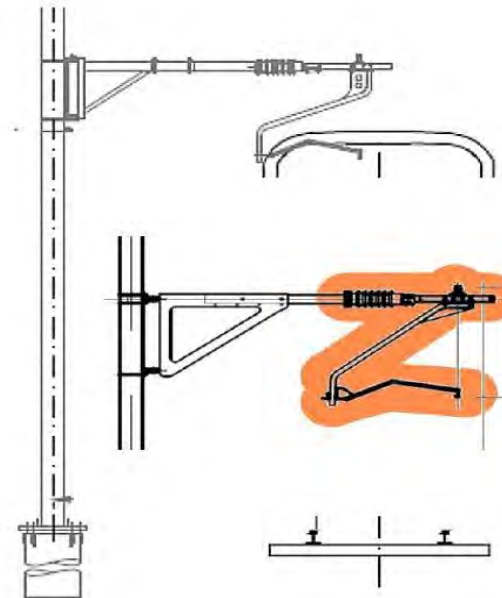
SERIES 1 Overview

Series 1 is the new overhead line equipment range for routes above 110 mph to be electrified. This is being implemented on Great Western Railway.

The Series 1 system is a modern lightweight Auto Tension 25kV 50hz AC system for operation at train speeds of up to 225 km/h (140mph) with multiple pantographs.



Traditional single cantilever
with live envelop



Series 1 equivalent with
live envelop

Headspans Mark3b OLE equipment



A head span structure is one where the support of OLE equipment is achieved solely by means of tensioned cables running between masts

Headspans are significantly cheaper, however they are more difficult to adjust subsequently and they are not mechanically independent.

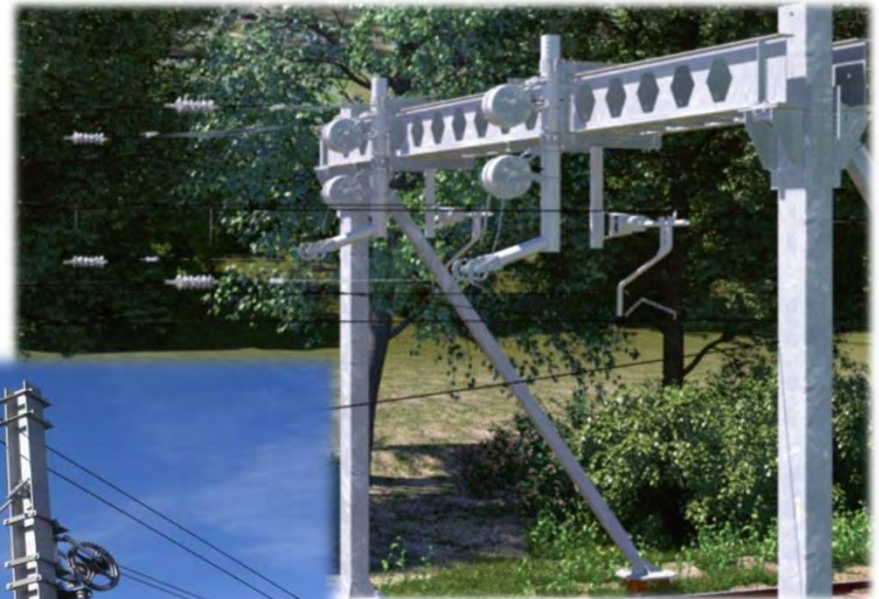
Series 1 tensioning system vs Traditional tensioning system

Modern systems are increasingly using spring tensioners (Tensorex C+) to achieve the required tension

The contact and catenary wires are independently tensioned

Allows the device to be placed over the track for ease of maintenance access

Eliminates the need for pulleys



Tensorex C+ on a monoboom anchor

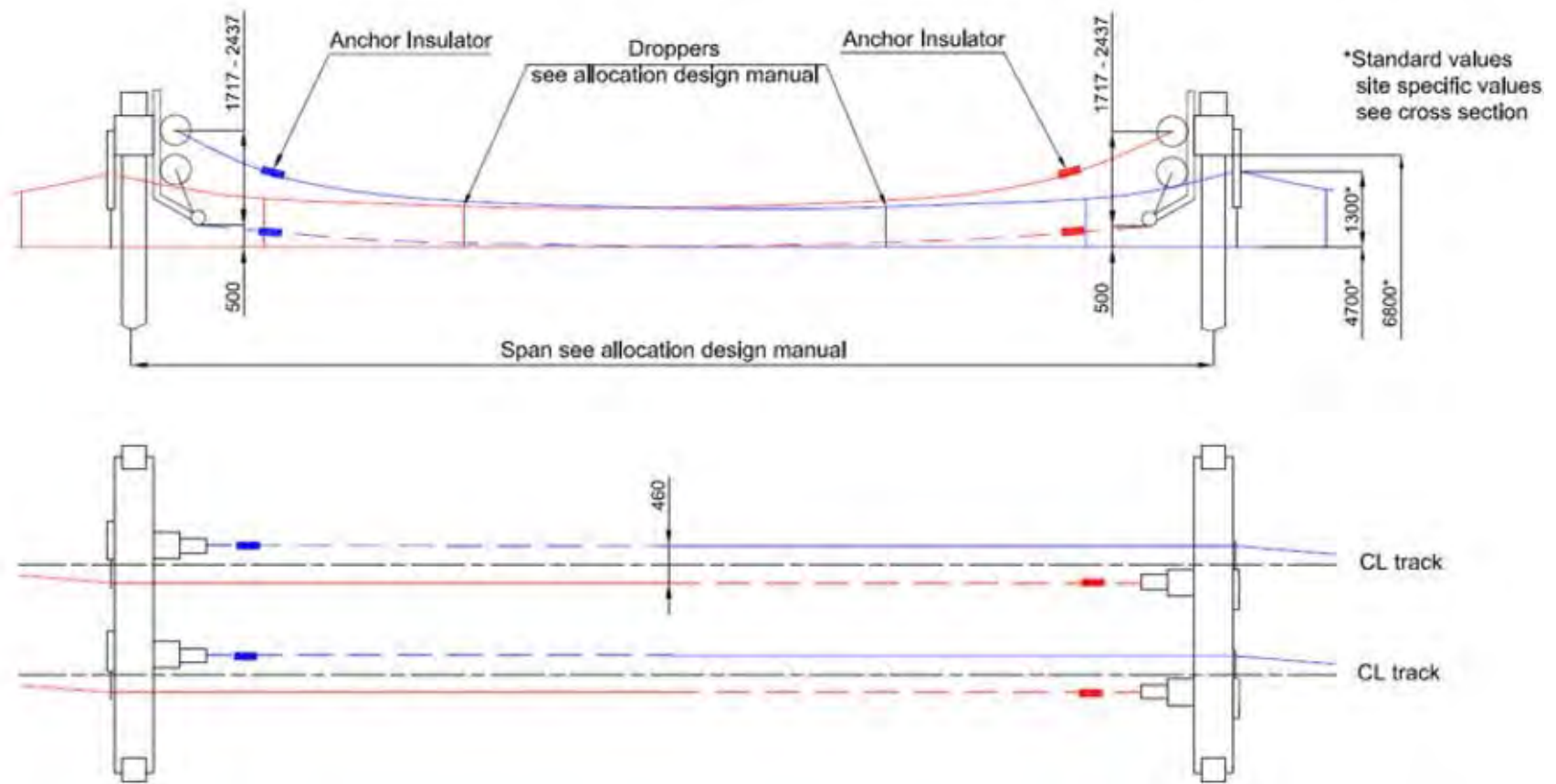


Traditional Balance Weight Anchor



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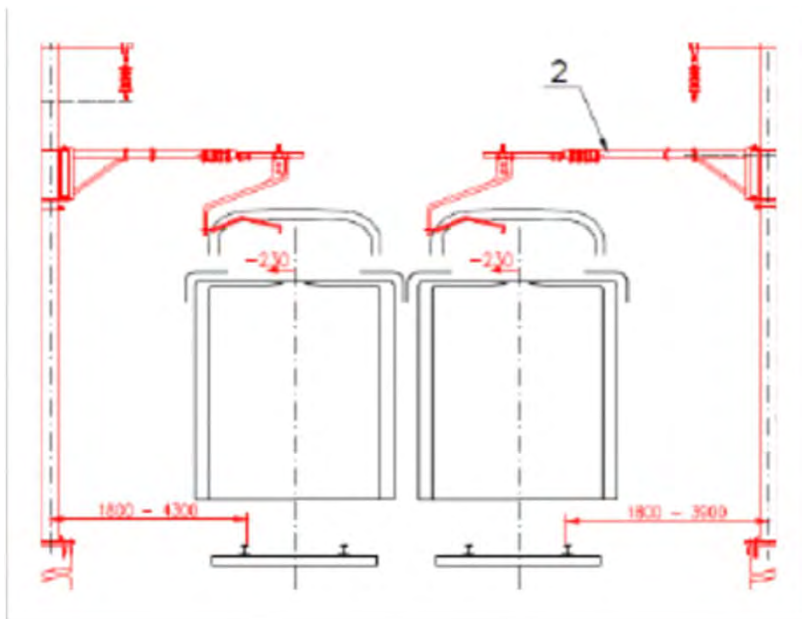
TWO TRACK SINGLE SPAN OVERLAP



SUPPORT AND REGISTRATION

- Single or Two Track Areas

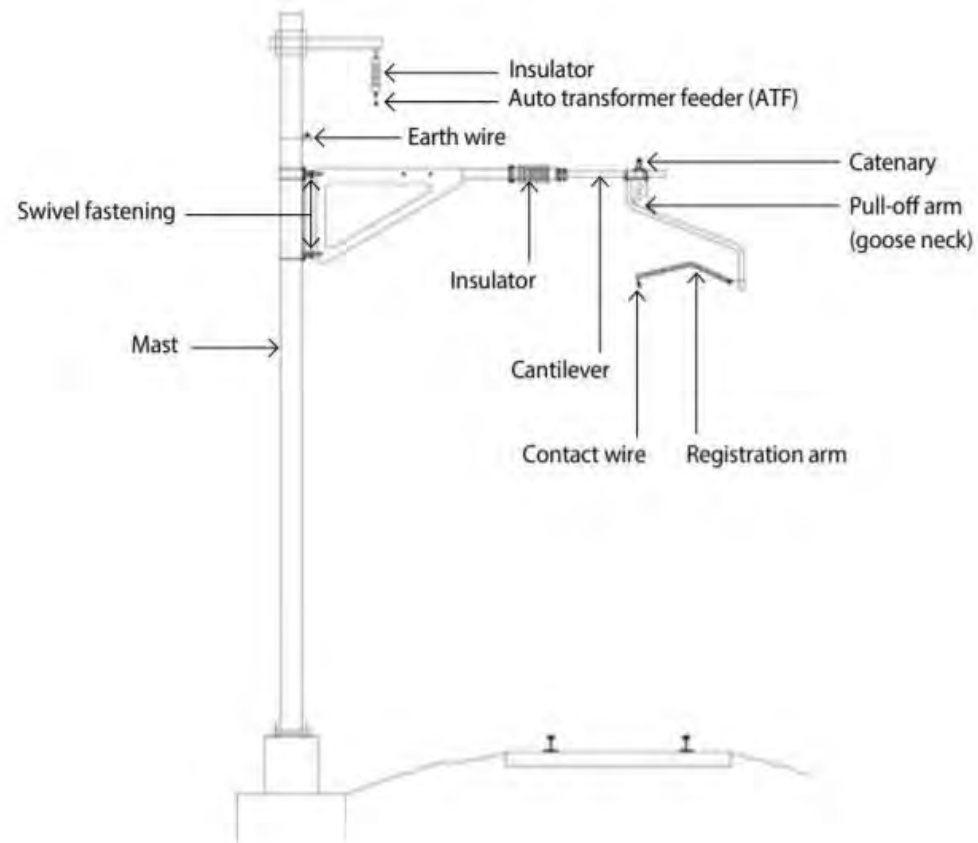
STC –Single Track Cantilever





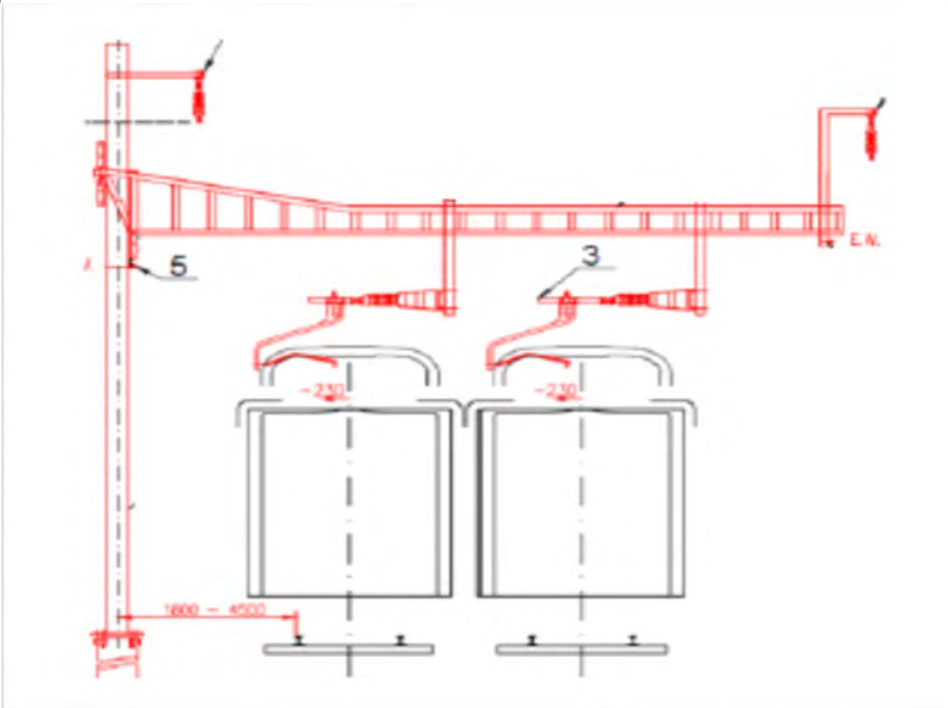
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OLE mast, cantilever and associated equipment



➤ Multiple Track Areas

TTC – Twin Track Cantilever



➤ Multiple Track Areas

Portal arrangement



Structures placed approximately every 50-60m to keep the electrified wires running between them under the correct tension for trains to pass safely.



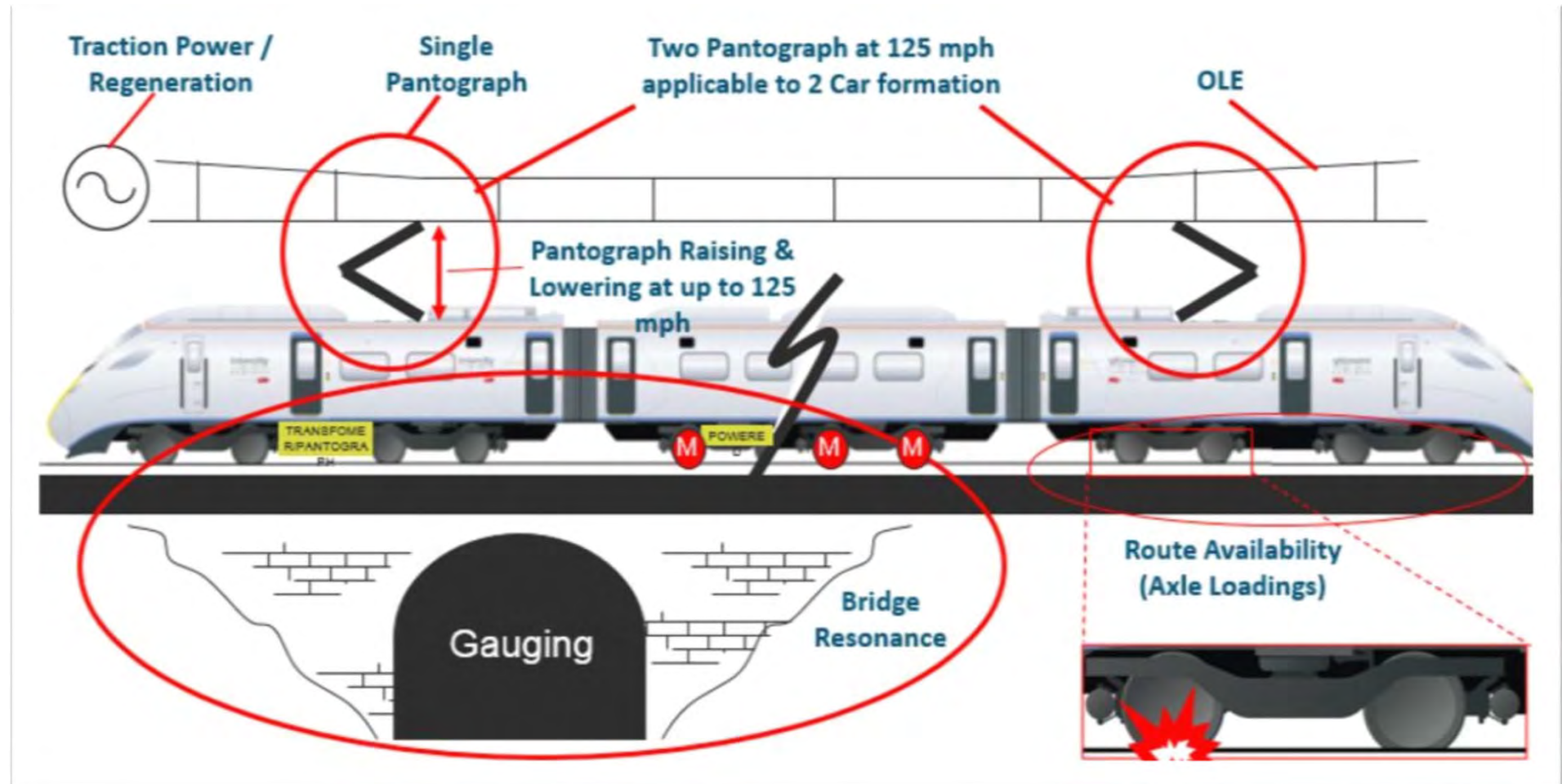
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The railway as a system



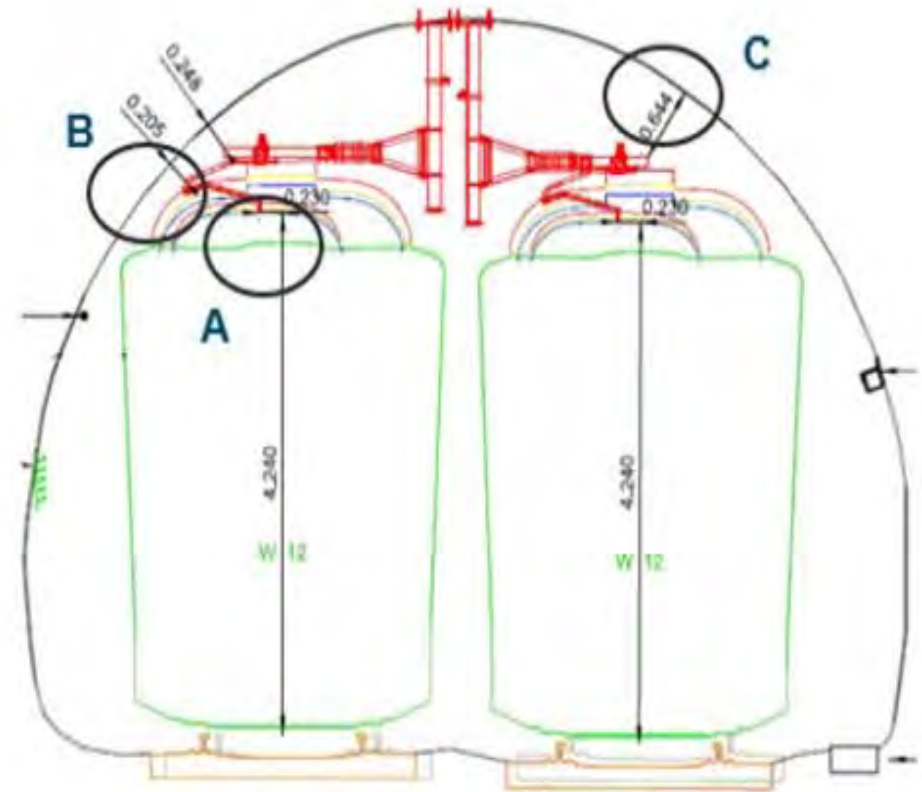
Train to Infrastructure Interface



The railway as a system

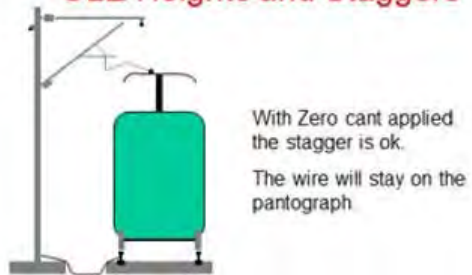
Clearances apply

- a) Between vehicle and wire
contact wire height
- b) Between pantograph and structure
pantograph gauge- affects wire height
- c) Between OLE and structure
Tripping/ bonding risk

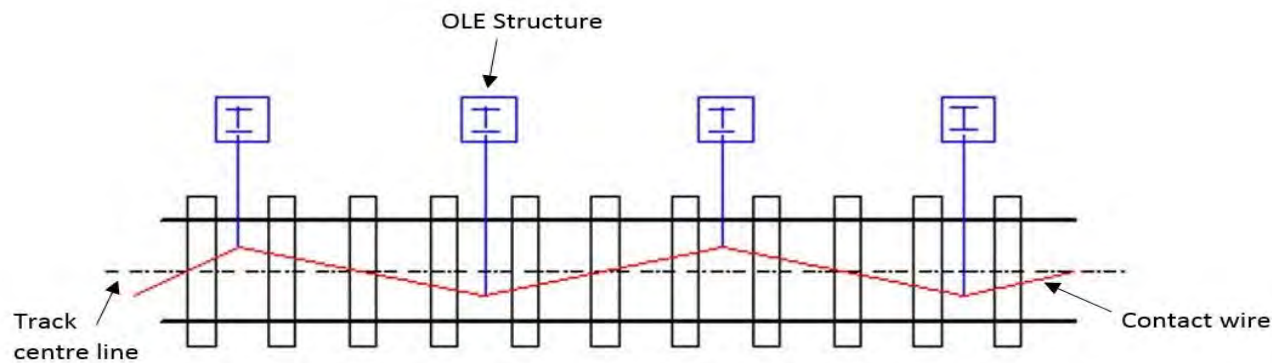
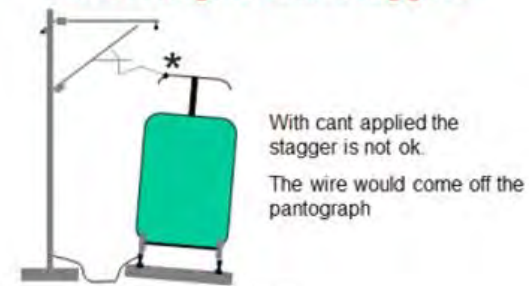


The railway as a system-OLE/ Track interface

Effect Track Design can have on
OLE Heights and Stagers



Effect Track Design can have on
OLE Heights and Stagers



1 mm change of track= *3 mm change
at OLE registration position



Pantograph types in use on Wales and Western



Pantograph types used on the Wales and Western region

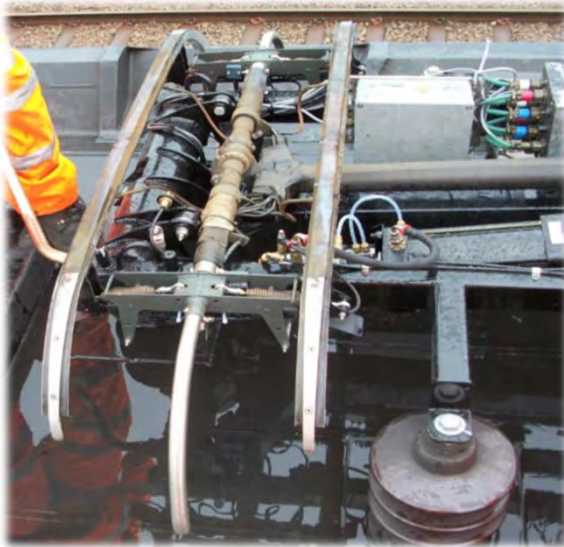
Operator	Train Class	Pantograph fitted	Train Manufacturer
Heathrow Express	332	BW HS-A	Siemens
Heathrow Connect	360	BW HS-P Mk 1	Siemens
Crossrail / MTR	345	BW HSP-Mk2	Bombardier
GWR	387	BW HSP-Mk2	Bombardier
GWR	769	BW HS-A	British Rail Engineering Limited (BBRL) & Brush Traction
GWR	800 series	BW HS-X	Hitachi



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Pantograph types

Brecknell Willis HS-X 'IET'



Brecknell Willis HS-P Mk2





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Pantograph types

**Brecknell Willis HS-P Mk2
(‘Class 345’s)**

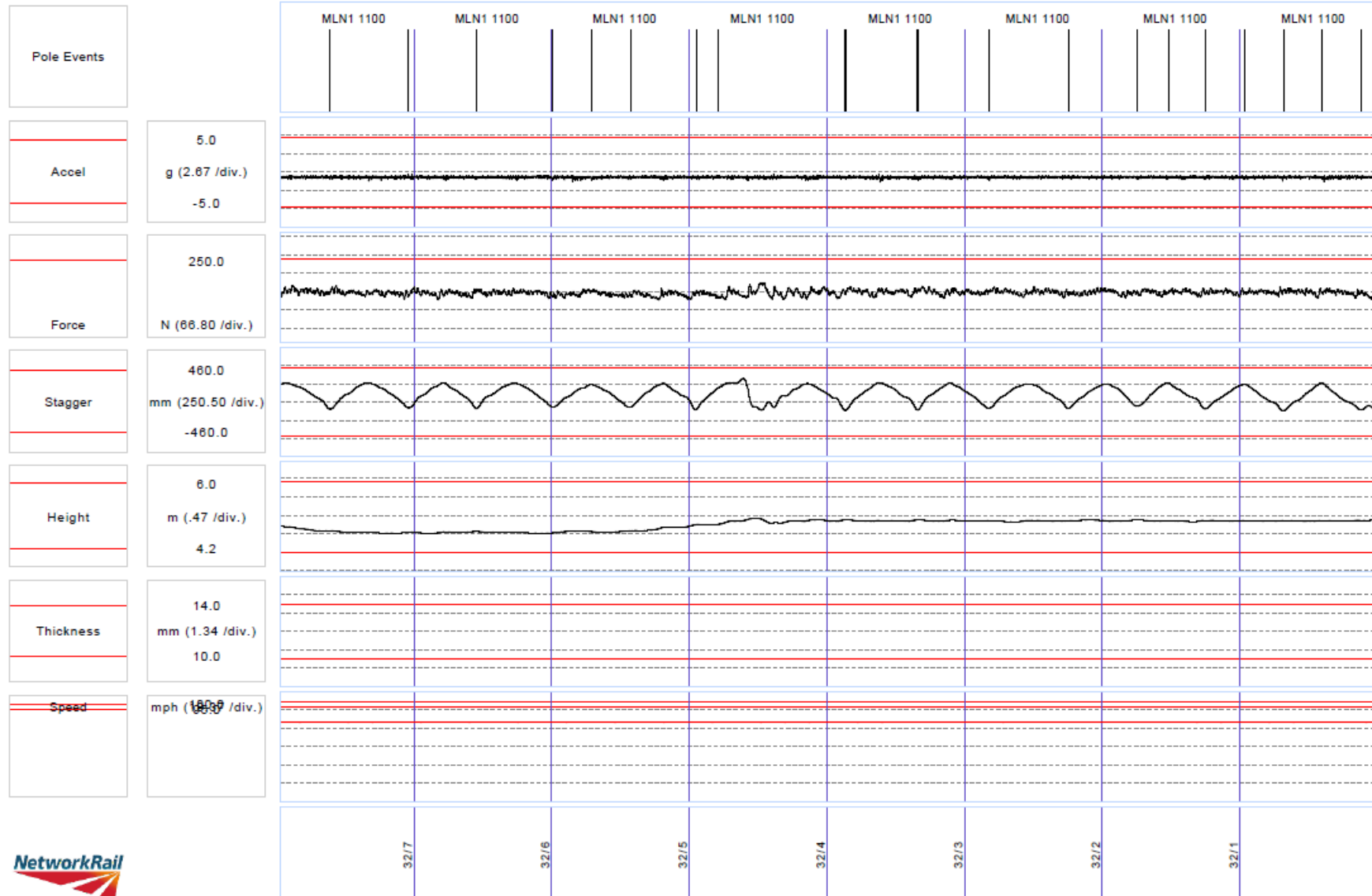


**Brecknell Willis HS-A ‘High Speed’
(‘Class 769’)**





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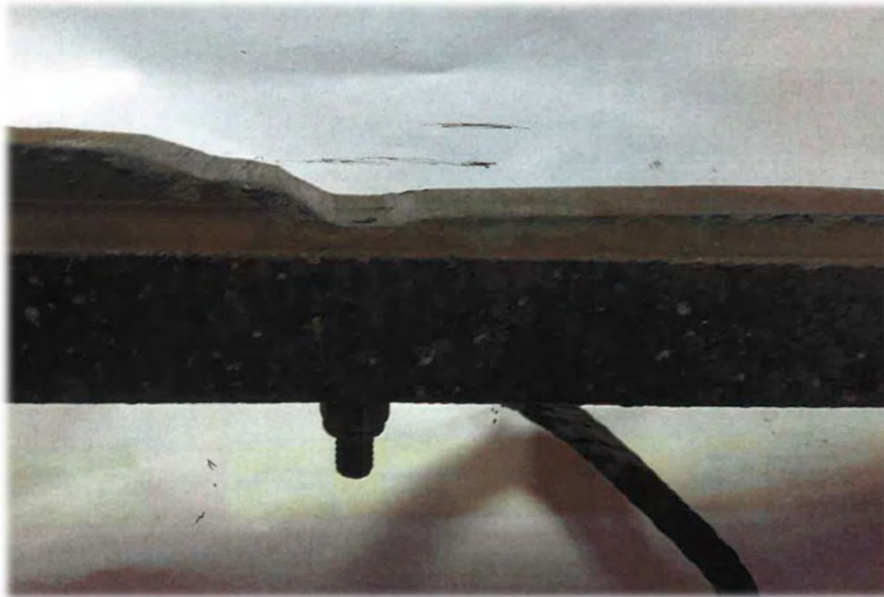




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Automatic Drop Device - ADD



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OLE Maintenance



New Overhead Line depots created to maintain the electrification system:

- Westbourne Park (existing)
- East (Reading and Westbourne Park)
- Central (Swindon & Bristol)
- Cardiff (Newport)



Engineering competencies

Ref Number	Competence Unit	Team Assistant	Team Member	Team Leader	Supervisor	Technician / Senior Technician
OLE 1	Undertake Preventive Maintenance of OLE assets		Core	Core	Core	Optional
OLE 2	Undertake Corrective Maintenance of OLE Assets			Core	Core	Optional
OLE 3	Establish the operational condition of OLE assets by Non Intrusive Inspection	Core	Core	Core	Core	Optional
OLE 4	Establish the operational condition of OLE assets by High Level Intrusive Inspection			Core	Core	Optional
OLE 5	Undertake preventive and corrective maintenance of Earthing / Bonding		Core	Core	Core	Optional
OLE 6	Effective progression of OLE maintenance or renewal activities			Optional	Core	Optional
OLE 7	Confirm the OLE is fit for Operational Purposes Following Work			Optional	Core	Core
OLE 8	Construct OLE Assets in Accordance with Design Drawings and Specifications			Optional	Optional	Optional
OLE 9	Confirm the OLE is safe for operational purposes between construction activities				Optional	Core
OLE 10	Effective progression of OLE construction Activities				Optional	
OLE 11	Reconstruct (Restore) the OLE to operational condition after a de-wirement			Optional	Core	Core
OLE 12	Undertake Technical Assessment of OLE assets					Core

In addition to the above those persons required to work on or have access to live OLE shall have sufficient competence to carry out their work without risk of danger to themselves or other persons. The competence units below have been identified as meeting the requirements for persons who undertake the duties for this work.

Level B

Authorised Person are required to hold the units as follows:

OLE. 13: Manually Switch Electrical Supply to OLE to Meet Defined Requirements

OLE. 14: Test and Earth OLE to Meet Defined Isolation Requirements

OLE. 15: Contribute to Minimising Risks When Working On or Near to Live OLE.

Applicable Sentinel codes are:

- Authorised Person - OLE AC Isolation AP OLE/AC-i
- Authorised Person – OLE DC Isolation AP OLE/DC-i

Level B: Switching & Object Removal from the OLE

Authorised Person who require the Switching & Object Removal from the OLE are required to complete the units as follows:

OLE. 17: Object Removal from the OLE

Applicable Sentinel codes are:

- Authorised Person – Switching & Object Removal AP OLE/S&R-i

Level A

Nominated Person are required to hold the all units in Level B and in addition shall complete the units as follows:

OLE. 16: Manage the Isolation and Earthing of OLE.

OLE Inspections

- Low level foot patrol (B01)
- High level intrusive inspections (B10s)
- High level early failure inspection (B11a)
- Asset condition inspections – wire wear (B13)
- Dynamic inspections – NMT & MENTOR inspection vehicles
- Thermal imaging inspections
- Pantograph video footage review
- On site investigations following a short circuit (B05)
- OLE ancillary equipment, APC magnets, bonding inspections and Height & Stagger inspections

Camera on the pole



Helicopter/ Thermal camera



Drones



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What can go wrong?





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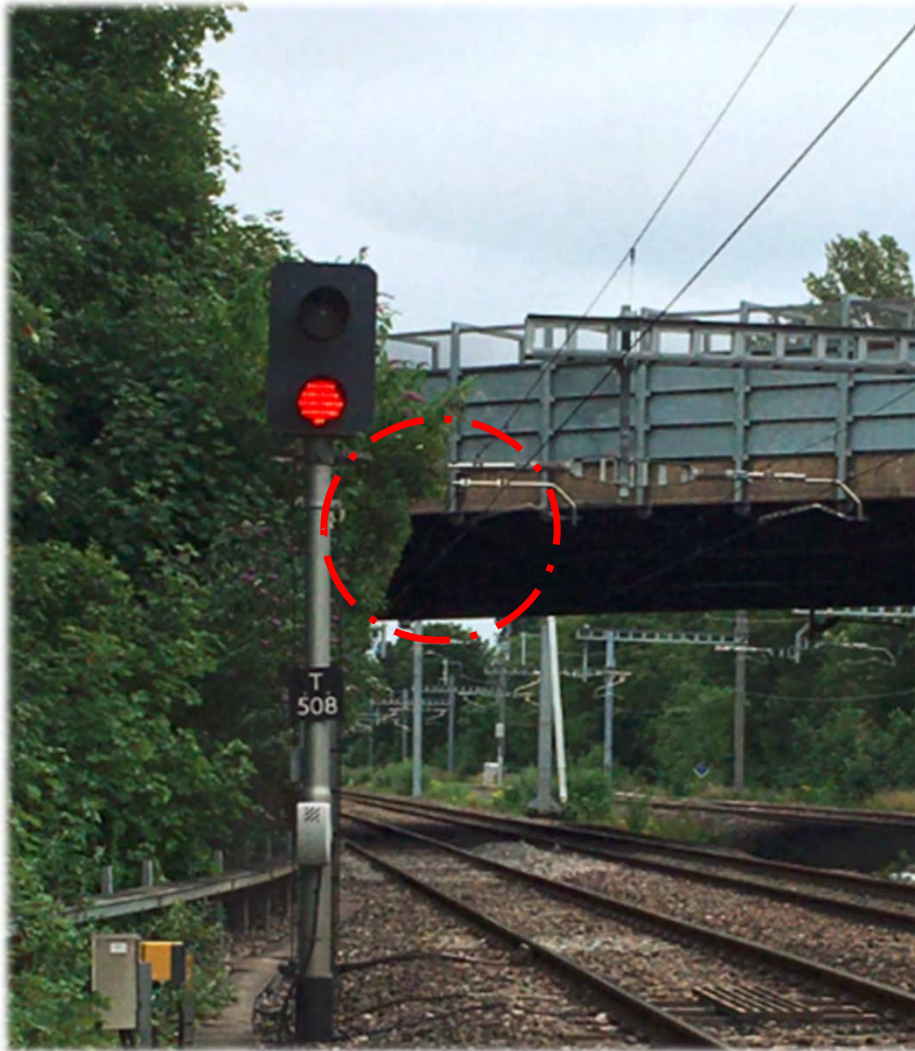
Birds – a big problem





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Vegetation – a challenge!





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Extreme weather – an increasing problem

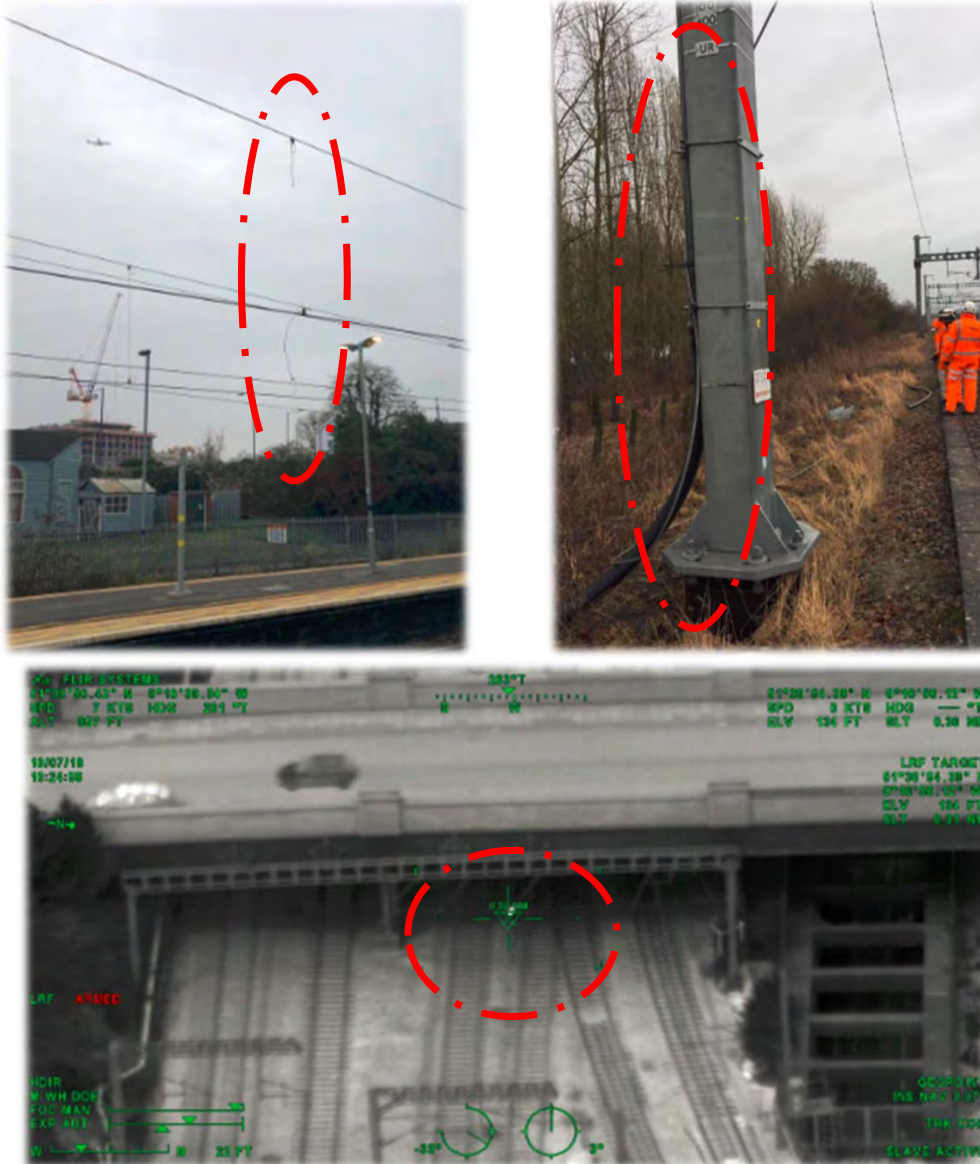




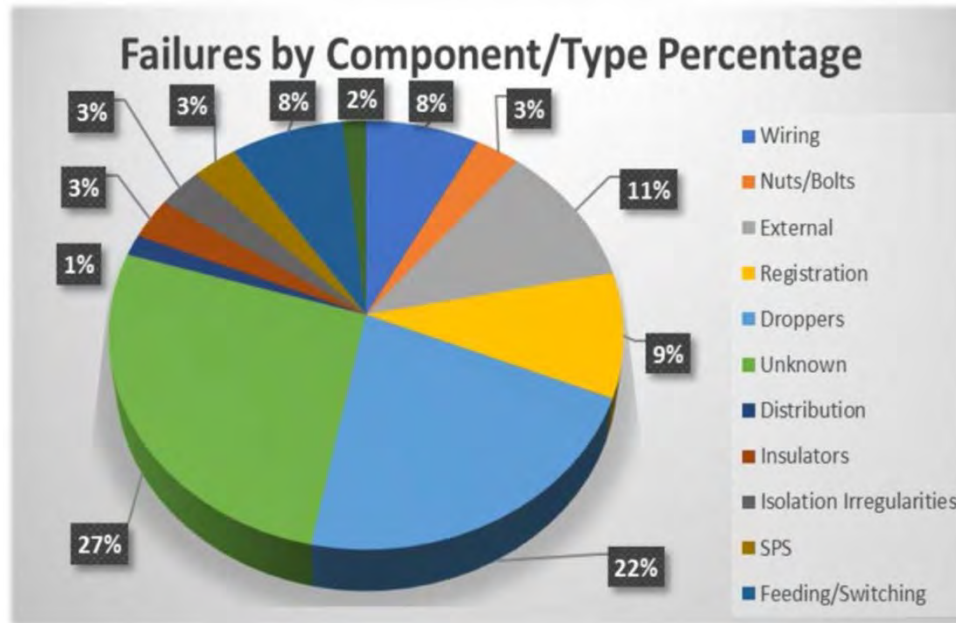
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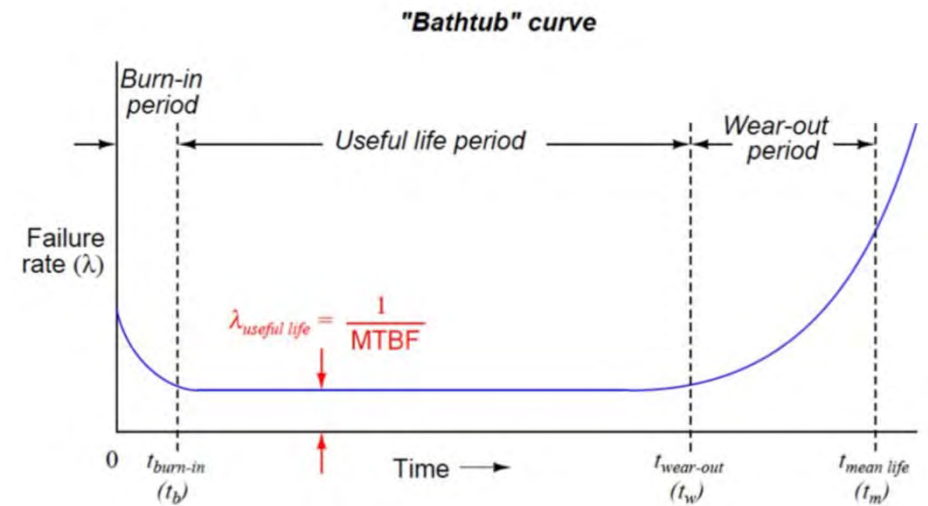
OLE construction snags and system defects



Extracts from SERIES 1 on GWEP Reliability Report



Bathtub Curve



Failure of Component/Type causing Service Affecting Failures

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Pantograph Monitoring Systems



Existing / obsolete pantograph monitoring on Network Rail areas

‘ PanChex ’ system

A legacy system known as PanChex used to measure contact wire uplift and associated parameters such as wind speed and vehicle speed.

This system was installed in the 1990s and is now obsolete.

Ricardo Rail’s ‘PanMon2’ system

Installed at 7 key locations across the Region, incorporating 16 scanners and offering 100% coverage of electric services operating within Scotland Region

Pan Mon Scanner at Hyndland Station



PantoBot3D –Heathrow side way installation

The PantoBot3D system has been installed at Heathrow since October 2018 as a Wayside option. The system is managed and maintained by Network Rail, and is presently being reviewed for product acceptance on Network Rail infrastructure.

Heathrow wayside installation

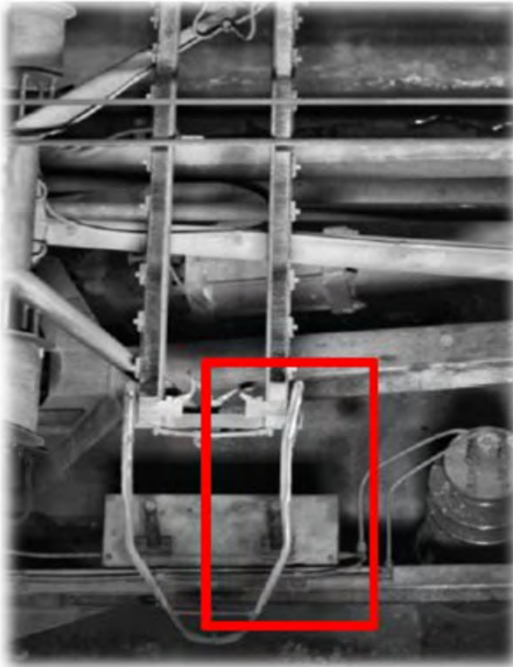




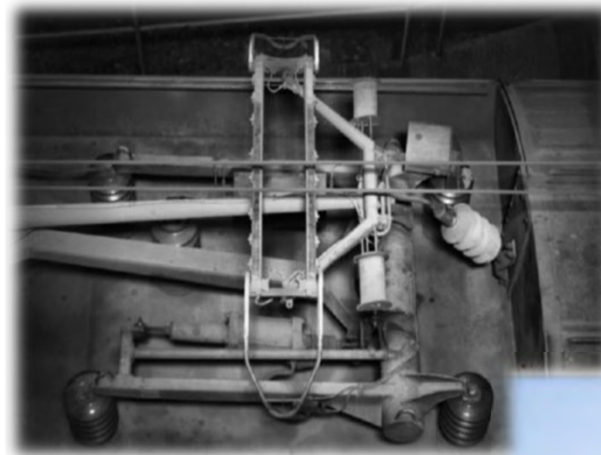
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Pantograph anomalies identified at Heathrow

Horn damage identified by
PANTOBOT 3D at Heathrow



Pantograph alarmed on a carbon chip
identified by PANTOBOT 3D at Heathrow



PantoBot3D –Locations on Wales and Western Route

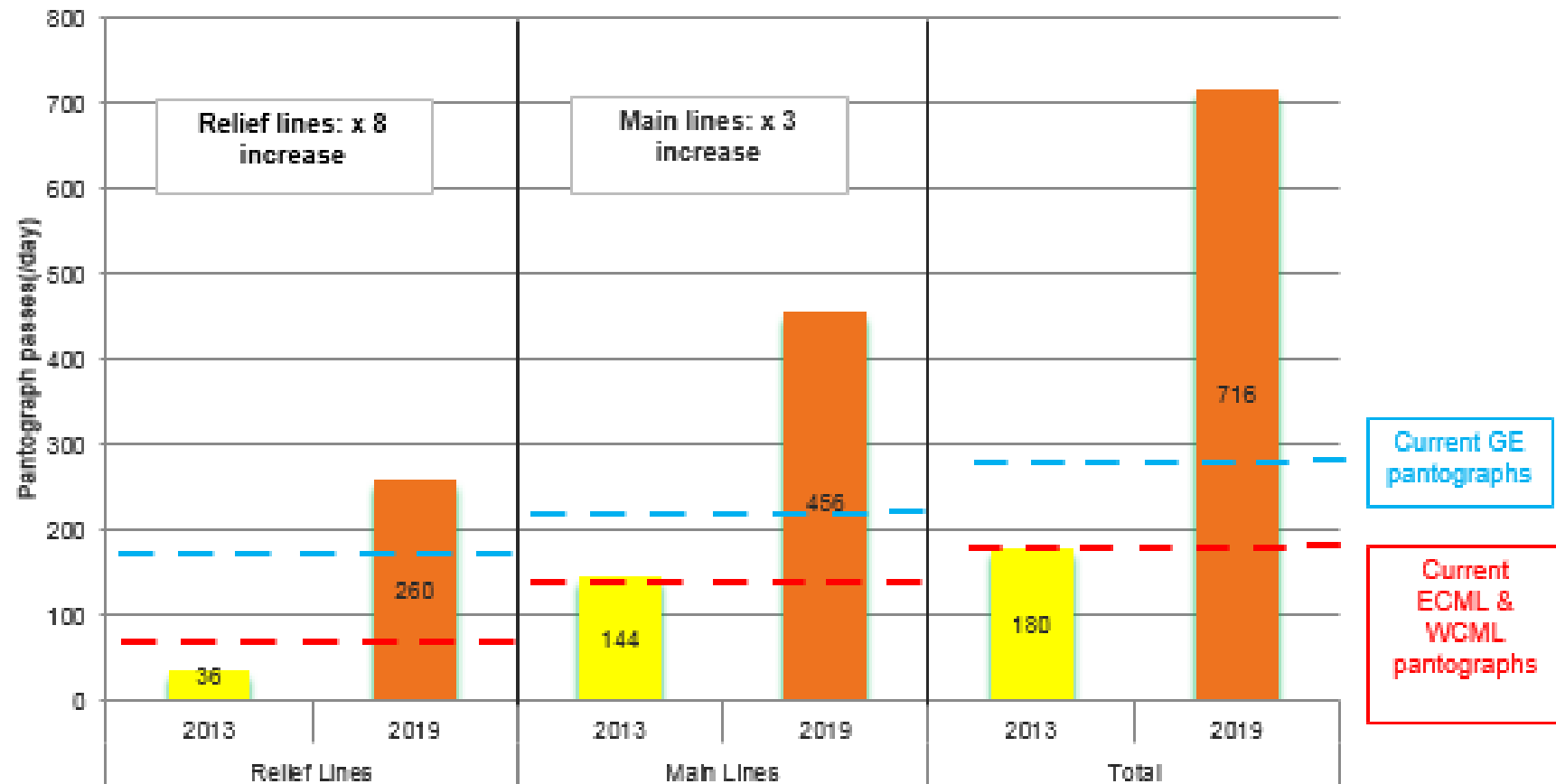
Swindon Training Centre OMF installation

On the Western Region the system will be an overhead Mounting Frame (OMF) installation.



Why Pantograph monitoring

MLN1 Paddington - Airport junction (0-12mp)

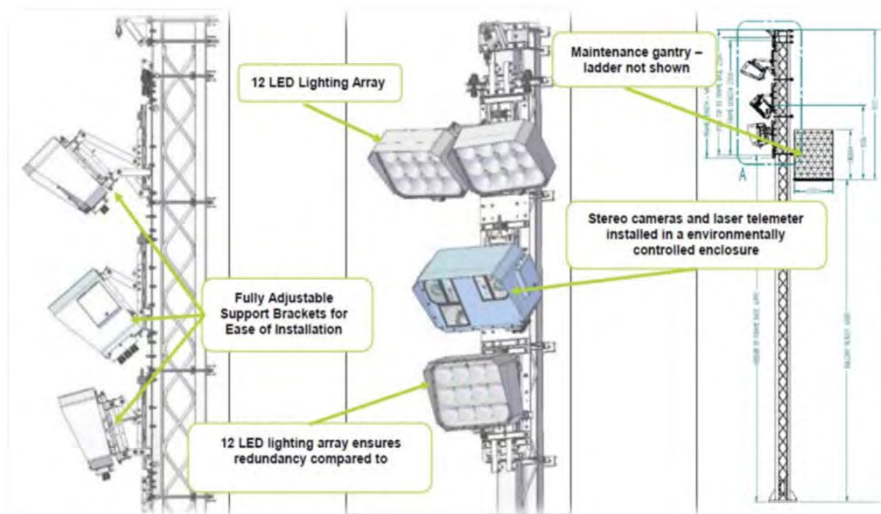


PantoBot3D System

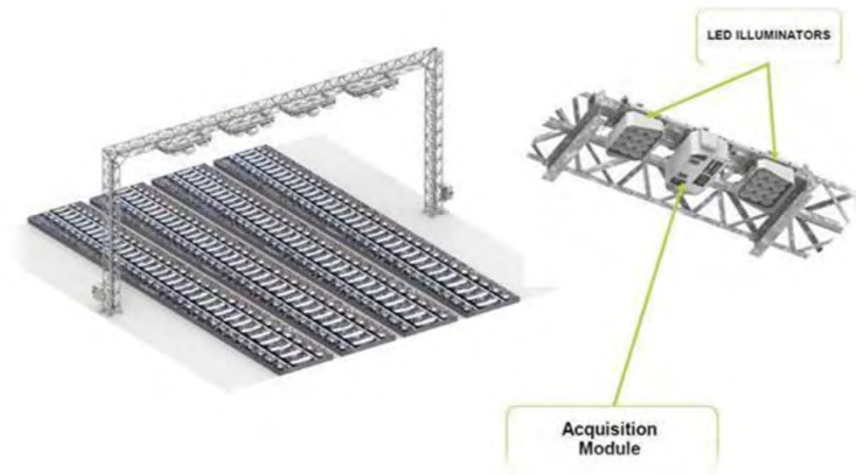
PantoBot 3D is designed to provide, in real time, pantograph condition monitoring and will therefore assist in the early identification of the root cause / location of damage to pantographs.

PantoBot 3D will alert Network Rail and TOC'S of pantographs that are outside operational limits. The Pantograph Monitoring System (PantoBot 3D) is to be fully installed and commissioned by Network Rail Capital Delivery Wales & Western, producing the required system outputs.

PANTOBOT 3D - WAYSIDE



PANTOBOT 3D - OVERHEAD MOUNTING FRAME (OMF)



PantoBot 3D KEY Futures:

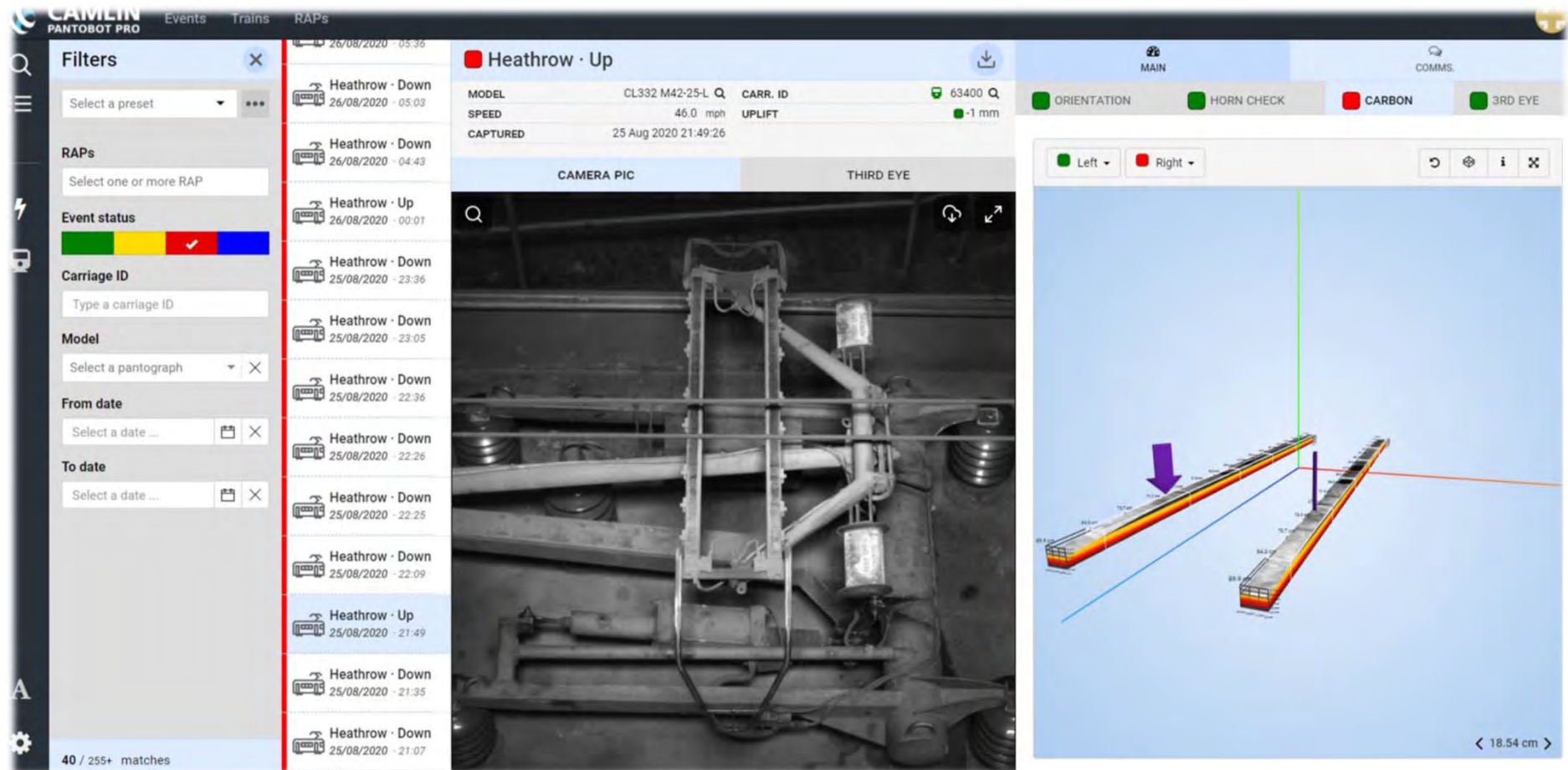
- ☐ Fully automated alerts (e-mail) notifications;
- ☐ Automatically recognize and classify the pantograph model;
-
- ☐ Missing or damaged horns
- ☐ Chipped carbon strip
- ☐ Objects in the Pan well
- ☐ Carbon strip wear
- ☐ Low or high uplift

Train ID



USER INTERFACE PANTOBOT PRO

Pantograph alarmed on carbon wear warning identified by PANTOBOT 3D at Heathrow

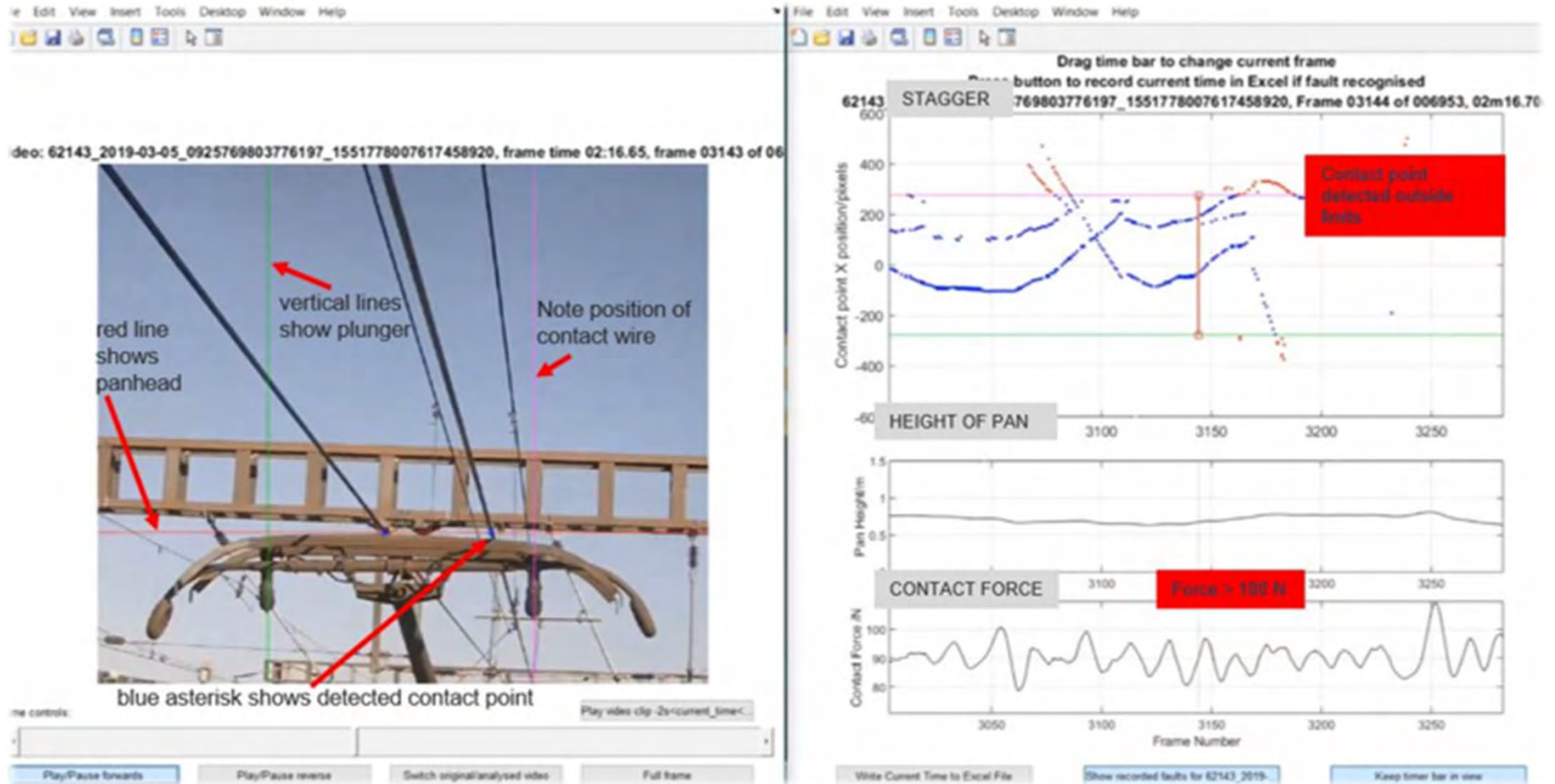


The screenshot displays the CAMLIN PANTOBOT PRO interface, which is used for monitoring pantograph systems. The interface is divided into several sections:

- Filters:** A sidebar on the left containing filters for RAPs, Event status, Carriage ID, Model, From date, and To date.
- Heathrow · Up:** A central panel showing the selected event. It includes details such as MODEL (CL332 M42-25-L), CARR. ID (63400), SPEED (46.0 mph), and CAPTURED (25 Aug 2020 21:49:26).
- CAMERA PIC:** A large image showing the physical pantograph assembly.
- THIRD EYE:** A 3D visualization of the pantograph system, showing the carbon contact and the pantograph arm. A purple arrow points to the carbon contact, indicating a wear warning.
- Orientation:** A control bar at the top right with buttons for ORIENTATION, HORN CHECK, CARBON, and 3RD EYE.

The 3D visualization shows the pantograph arm with a color-coded scale indicating wear levels. A purple arrow points to the carbon contact, which is highlighted in red, indicating a carbon wear warning. The scale shows values ranging from 0.0 to 10.0 mm.

OLE and Pantograph Image Recognition (Olert)- Overview





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Mission- Predict & Prevent

**Decrease the time taken to
investigate failure**

**Option of including 'statistical and trending
analysis' to save time and cost preparing report**

Avoid disruption to train services

Railway operators to make informed decisions



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Q & A