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Electrification Cost Reduction: Digital Design and Challenging the Rules

Garry Keenor

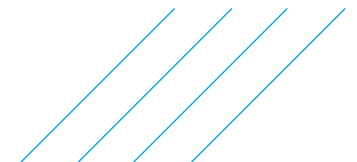
Professional Head for Electrification,
Transportation

Talk Contents

- › The need to challenge existing methods
- › Atkins first principles capability
- › Current R&D projects:
 - › Reducing uplift through measurement
 - › Gradient modelling
- › Applying emerging standards – challenge to designers
- › Applying emerging standards – challenge to clients



Electrification: The Current Landscape

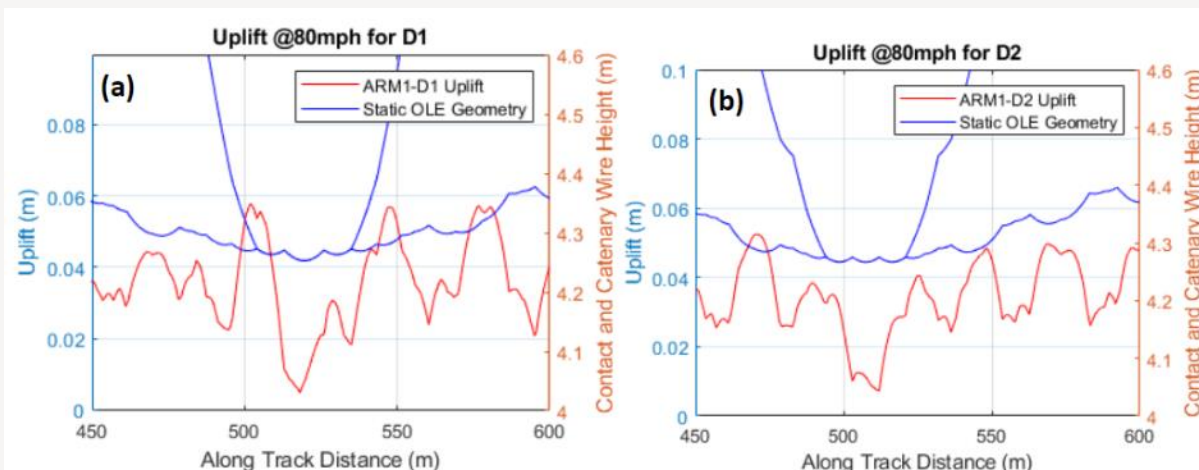
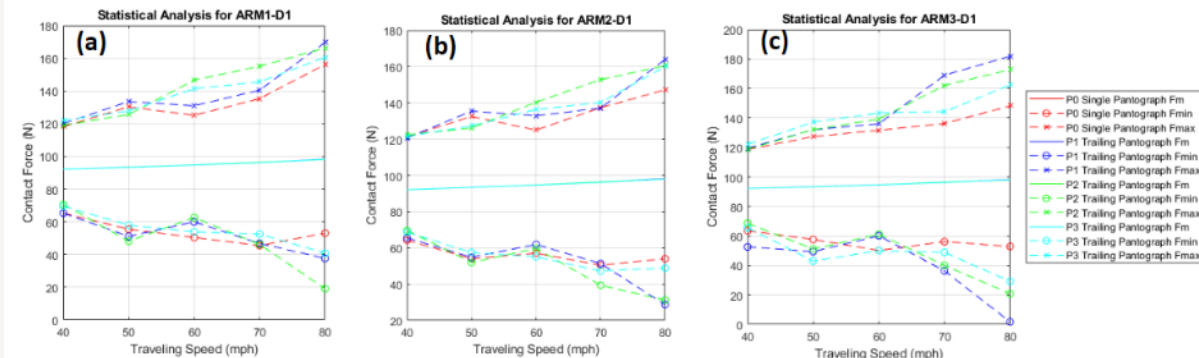
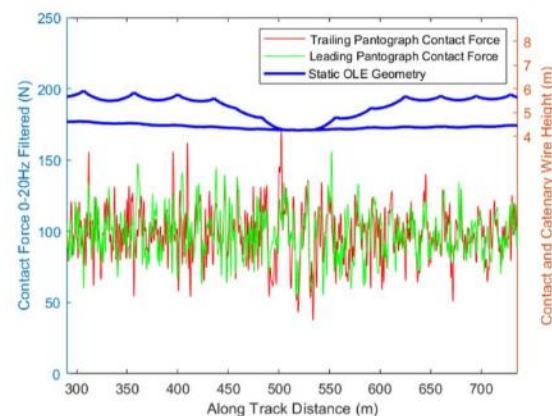


The Atkins First Principles Approach

Current Collection Criteria at the pantograph to OCS interface

Speed (mph)	80
F_m	98.2
F_{min}	37.68
F_{max}	169.58
σ	17.72
σ/F_m	0.18
$F_m - 3\sigma$	45.03
$F_c < 25N$	0
Uplift max (mm)	67
Uplift BA (mm)	8
NQ (%)	0

OCS Geometry with generated Contact force of P1 leading and trailing pantograph – D1



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Intelligent Rule-Breaking: Digital Techniques to Reduce Electrification Costs



OLE Design Rules – Time For Change

Infrastructure Projects

Southern





NetworkRail

UK Master Series

System Description Manual

Issue 1.2

24th February 2017

Document Number:

141667-FAF-MAN-EOH-000001



UK Master Series System Description 1.2
141667-FAF-MAN-EOH-000001

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2.3. Contact wire grading

the contact wire grading shall be in accordance with the following table:

Value	Value
Gradient up to 80mph (130km/h)	1:400
up to 125mph (200km/h)	1:5 times the line speed in mph
gradient up to 125mph (200km/h)	1:10 times the line speed in mph
above 125mph (200km/h)	1:1000
gradient above 125mph (200km/h)	1:2000

as are not applicable at overbridges where specific grading rules are specified on the management drawings.

2.4. Maximum contact wire stagger and deviation

osition, the contact wire deviation shall not exceed 350mm at a contact wire height of 4.7m. num design in-running stagger at a contact wire height of 4.7m is 320mm. uses reduce by 40mm per metre of wire height increase.

2.5. Contact wire blow-off

num contact wire blow-off shall be calculated in accordance with NR/L2/CIV/072. er change due to along track movement is restricted to 50mm.

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6.1.1. Standard tension length

standard tension length configuration can be broken down in to four generic cases:
rack route with 3 span overlaps using cess terminations;
rack route with single span overlaps and anchor portals;
lli-track with single span overlaps and anchor portals;
lli-track with 3 span overlaps and anchor portals.

ll details refer to drawing MS/B01/B01/A3 and MS/B01/B02/A3.

6.1.2. Overlap design

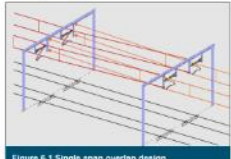
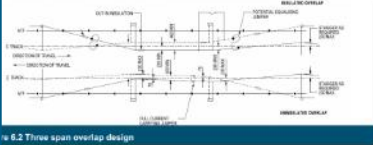


Figure 6.1 Single span overlap design

UK Master Series contains three span overlap configurations.
e span overlaps will be added in future.



6.2 Three span overlap design

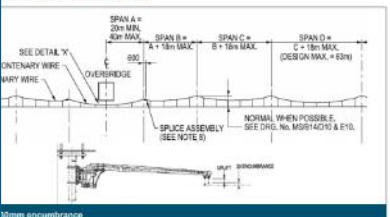
ll details of overlap configurations refer to drawings MS/B04/B01/A3 to MS/B04/B04/A3 and to the Allocation Design Manual for application rules.

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6.1.5.3. 30mm encumbrance

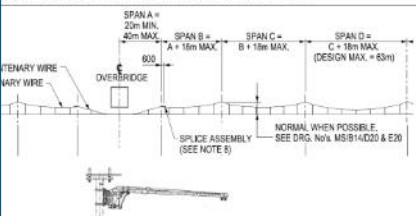
umbrance solution is applicable to UKMS100 and UKMS125(up to 125mph). See 3/B08/B02/A3 sheet 2 for details.



30mm encumbrance

6.1.5.4. Zero encumbrance

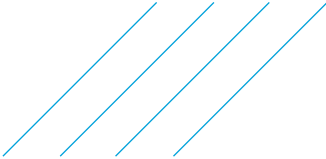
umbrance solution with independent bridge arm for each wire is applicable to UKMS125 (y up to 125mph). See drawing MS/B06/B02/A3 sheet1 for details.



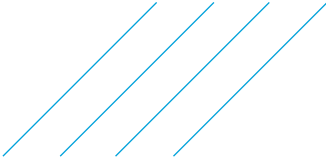
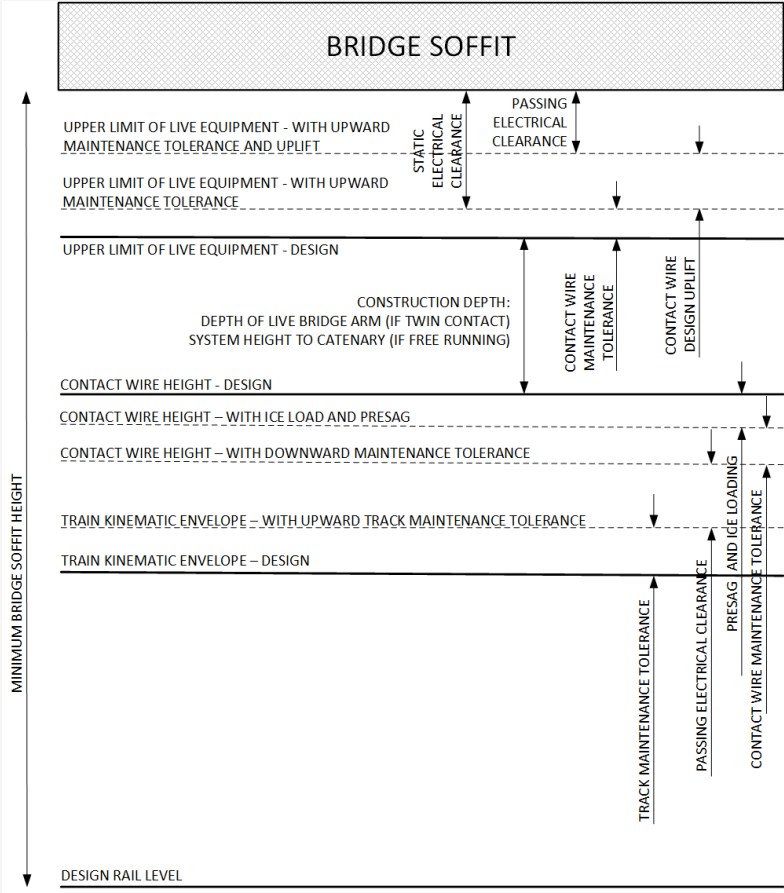
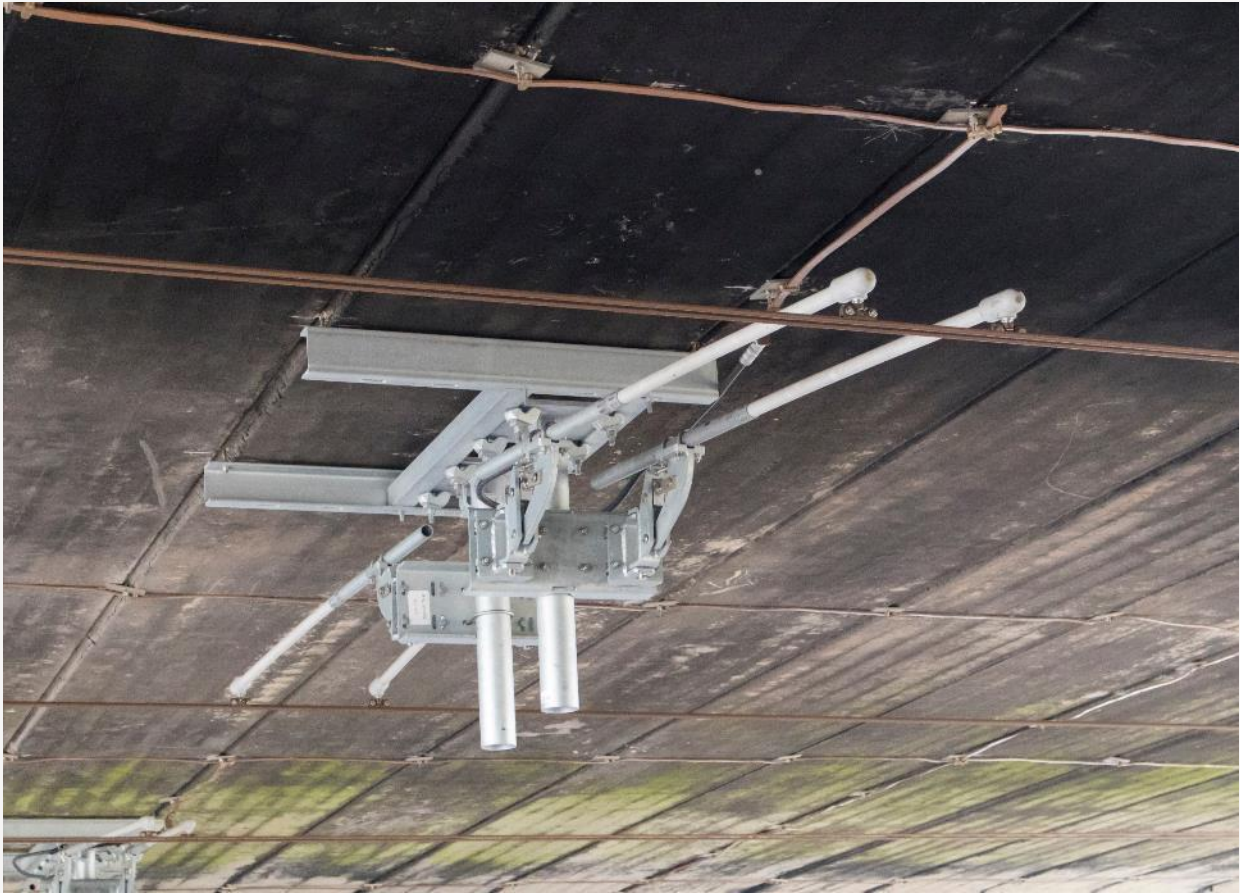
Zero encumbrance

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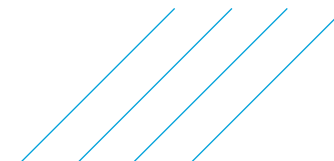
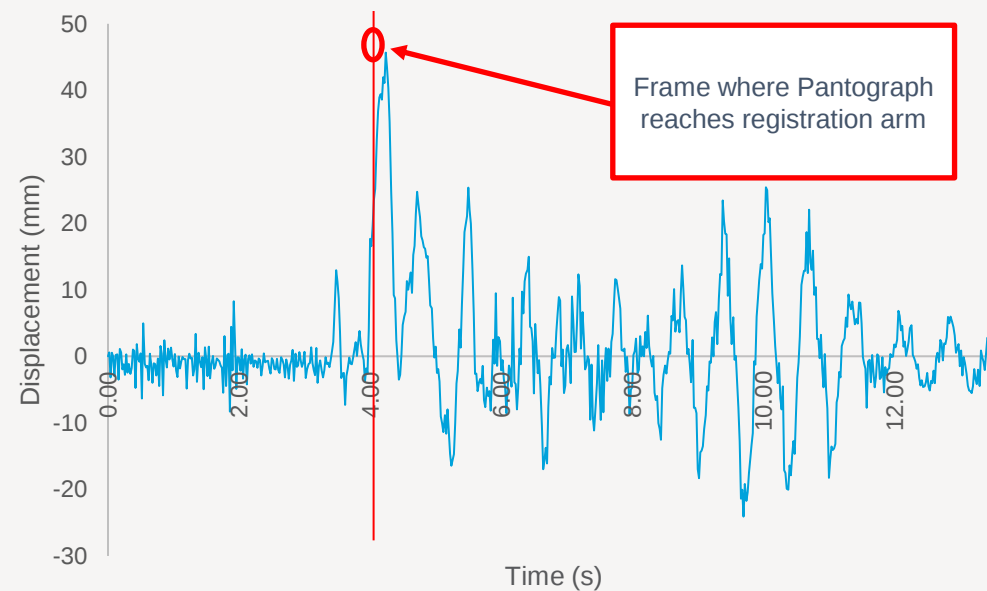
Influencing the New Policies - Uplift Modelling & Measurement



Uplift Measurement – A New Technique



Bourton Bridge - 2x5 Car Class 800 - Uplift at Registration Arm



Uplift Measurement – The Results

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Digital Image Correlation

**Midland Mainline Electrification - High Speed Uplift
Measurement, Irchester, 8th March 2021**

**12 Car Electric Multiple Unit travelling at 110mph -
11:09 pass on Up Fast**

No track access, no equipment on OLE



Uplift Measurement: The Results

Section 8 shows that use of a 45mm design value is in fact moving the industry back towards prior best practice as encapsulated in the 1987 version of drawing 1/111/100, and that the data from Old Dalby also supporting this proposal.

Recommendation 1: The design uplift for all Mark 3b and Rebosio bridge arms should be amended to a value of 45mm. This value should be applied to twin contact bridge arm locations at all speeds up to, and including, 125mph, and should be applied on all current Network Rail auto-tensioned systems. This should be regarded as an interim rule for all speeds, pending further measurement and assessment to allow a speed-uplift relationship to be defined.

The scope of this study does not include Fixed Termination equipment, and it is possible that equipment with a variable tension will experience higher uplift values, especially during periods of high ambient temperatures. This is potentially counterbalanced by the tendency of FT equipment to be operating at lower linespeeds, but at present there is insufficient data to be sure about the magnitude of any reduction from the current design value.

OFFICIAL

Ref: 12-21-002-V1a
Date of issue: 17/12/2021
Location: National
Contact: Richard Stainton,
Engineering Expert

Technical Authority
Providing technical leadership



V4

884 **10.6.2 Uplift of the contact wire by the pantograph and dynamic movement of**
885 **the contact wire (a6)**

886 **10.6.2.1 Requirement**

887 Uplift shall be provided for both the bridge arms and the contact wire.

888 **Values**

889 The following values shall be used.

Component	Value [mm]
Bridge arm	43
Contact wire	77

890 **Table 15 – Uplift values**

891 **Probabilistic assumptions**

892 If undertaking a probabilistic assessment of uplift, normal (Gaussian) distribution
893 shall be applied using the values below.

Component	Mean [mm]	Standard deviation [mm]
Bridge arm	+20.7	7.3
Contact wire	+41.8	11.7

894 **Table 16 – Probabilistic uplift values**

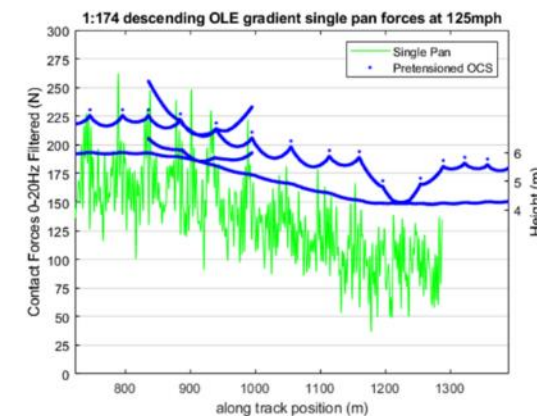
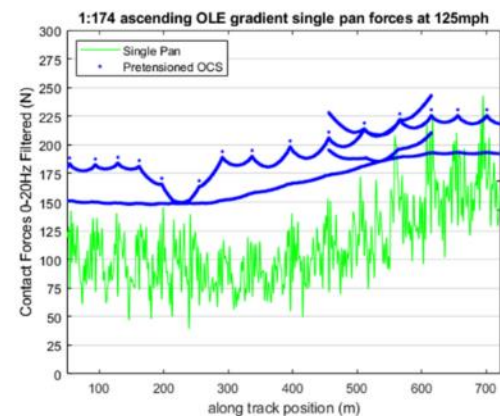
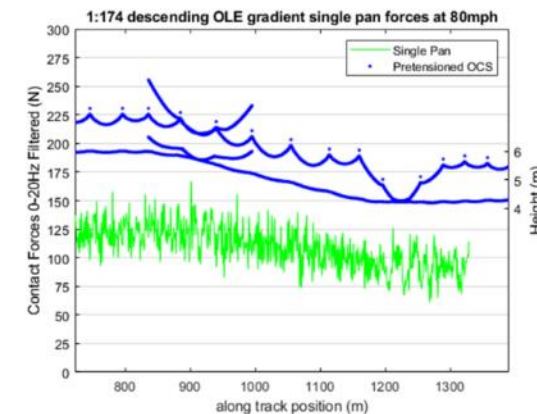
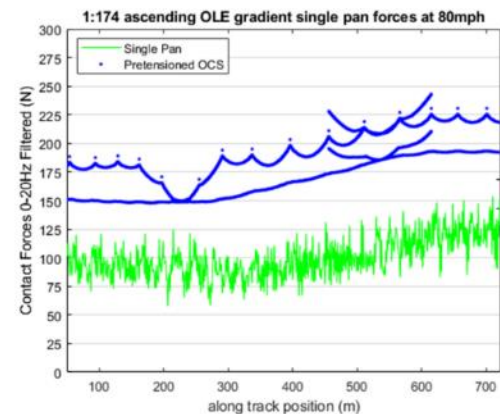
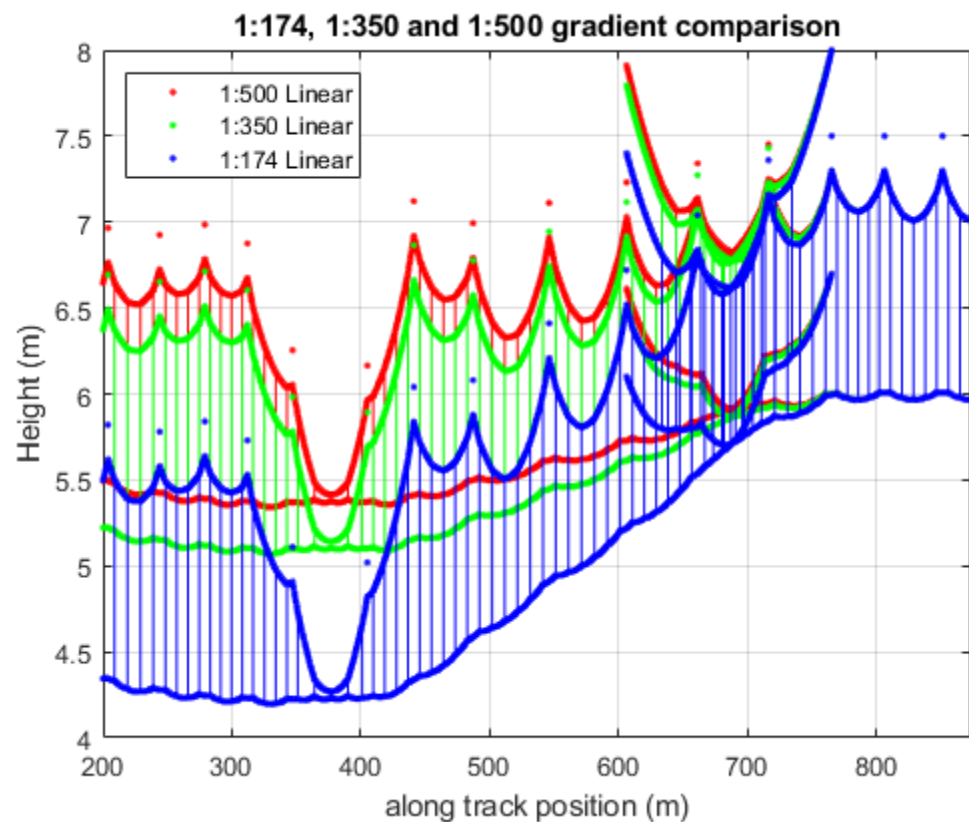
895 **10.6.2.2 Rationale**

896 These values have been determined via measurement of uplift in normal operating
897 conditions as part of the cost-efficient electrification project. This measured a wide
898 range of OCL in various stages of lifecycle.

899 This parameter contributes to SRACs 08.



Influencing the New Policies - Gradients Modelling



Cost Reduction: What can Network Rail and Contractors Do?

Ref: 12-21-001-V1
Date of issue: 15/12/2021
Location: National
Contact: Ruth Thomas, Senior Engineer, Contact Systems

Technical Authority
Issued by Technical Authority

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E&P Technical Advice Note
Bridge parapets electrical risk assessments

Advised Actions

To enable efficient electrification, bridge reconstruction to accommodate the overhead contact system should be avoided wherever possible.

This EPTAN introduces a structured means of carrying out an electrical risk assessment at a bridge to determine the required interventions to parapets and other arrangements.

Project managers and designers should use this process to determine the interventions required for each bridge on a railway where new electrification is proposed.

Distribution list

- Technical Head of Discipline [Contact Systems]
- Regional E&P Engineering Leads
- Project Engineers

The above recipients should distribute and onward brief to affected parties as necessary.

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Ref: 12-21-002-V1a
Date of issue: 17/12/2021
Location: National
Contact: Richard Stainton, Engineering Expert

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E&P Technical Advice Note
Electrical and mechanical clearances on overhead electrified railways

Advised Actions

To enable efficient electrification, bridge reconstruction to accommodate the overhead contact system should be avoided wherever possible.

This EPTAN introduces a structured means of carrying out an electrical and mechanical clearance assessments.

Project managers and designers should use this process to determine the interventions required for each bridge on a railway where new electrification is proposed.

Distribution list

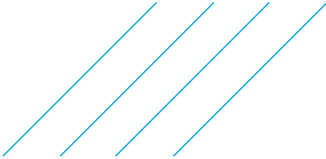
- Technical Head of Discipline [E&P]
- Project Engineering Managers [Electrification]
- Project Engineers

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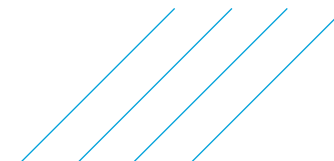
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Cost Reduction: What Can Designers and Clients Do?



Conclusion

