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Provision of Signage at Power Changeover Locations

Synopsis

This document sets out requirements and guidance for provision of signage at power changeover locations for multi-mode rolling stock.

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Issue record

Issue	Date	Comments
One	05/03/2022 (proposed)	Original document.

Revisions have not been marked by a vertical black line because it is an original document.

Superseded documents

This standard does not supersede any other Railway Group documents.

Supply

The authoritative version of this document is available at www.rssb.co.uk/standards-catalogue. Enquiries on this document can be submitted through the RSSB Customer Self-Service Portal https://customer-portal.rssb.co.uk/

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Part 1 Purpose and Introduction

1.1 Purpose

1.1.1 This document sets out requirements for the provision and characteristics of signage to support power changeovers (PCO) by multi-mode rolling stock.

1.1.2 Requirements and guidance for the design of multi-mode rolling stock and for the design of infrastructure and equipment associated with its use are set out in RIS-2713-RST *System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock.* These include the following topics:

a) development of a PCO strategy as part of any change that introduces multi-mode rolling stock to any part of the GB mainline network, which determines the methodology of PCO operation that will be employed, dynamic or static, manual or automatic
b) siting of PCO locations where the fixed subsystems are technically and operationally compatible with undertaking the relevant PCO process
c) design of locations for static PCO
d) design of locations for dynamic PCO.

1.1.3 Multi-mode rolling stock in RIS-2713-RST *System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock.* is defined as being rolling stock with more than one source of energy for traction power, at least one of which is external. RIS-3784-TOM also includes requirements when changeover is between two sources of self-powered or external traction on the traction unit concerned.

1.1.4 Application of the requirements of this standard will contribute to supporting the successful integration of multi-mode rolling stock into the operational railway, and driveability of a route so far as multi-mode rolling stock is concerned.

1.2 Application of this document

1.2.1 Compliance requirements and dates have not been specified because these are the subject of internal procedures or contract conditions.

1.2.2 If you plan to do something that does not comply with a requirement in this RIS, you can ask a Standards Committee to comment on your proposed alternative. If you want a Standards Committee to do this, please submit your deviation application form to RSSB. You can find advice and guidance on using alternative requirements on RSSB's website www.rssb.co.uk.

1.3 Health and safety responsibilities

1.3.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

1.4 Structure of this document

1.4.1 This document sets out a series of requirements that are sequentially numbered. This document also sets out the rationale for the requirement, explaining why the requirement is needed and its purpose and, where relevant, guidance to support the requirement. The rationale and the guidance are prefixed by the letter 'G'.

1.4.2 Some subjects do not have specific requirements but the subject is addressed through guidance only and, where this is the case, it is distinguished under a heading of 'Guidance' and is prefixed by the letter 'G'.

1.5 Approval and authorisation of this document

1.5.1 The content of this document will be approved by TOM Standards Committee in February 2022 [proposed].

1.5.2 This document will be authorised by RSSB in February 2022 [proposed].

Part 2 Requirements for signage at power changeover locations

2.1 Principles

2.1.1 The driveability of each power changeover (PCO) location shall be assessed to confirm that the information provided by the PCO system is suitable and sufficient to inform the train driving task throughout the PCO process.

2.1.2 The assessment shall be carried out again on each occasion when there is a change in the operational requirements.

Rationale

G 2.1.3 This is a contribution to safe integration. Poor driveability of a PCO location is a hazard that could impact on train operations. The driveability assessment considers the impact of the PCO process on the train driving task taking account of the operational context applicable throughout the PCO process.

G 2.1.4 Signage is only one of a range of controls that support PCO being carried out successfully. The PCO strategy required by RIS-2713-RST *System Requirements for the Introduction and Operation of Multi- Mode Rolling Stock* determines the nature of PCO, location and design for any PCO location, and this assessment is necessary to arrive at the most appropriate provision and location of signage to support those decisions.

Guidance

G 2.1.5 If the train driving task includes PCO control or monitoring functions, lineside operational signs can be used to remind the driver of necessary actions. The following parameters are relevant when assessing the fitness for purpose of the information provided:

a) What information is provided to the driver
b) Which sign or indication is used to provide the information
c) Where the information is provided, either in the cab or at the lineside
d) When the information is provided during the PCO sequence

G 2.1.6 RIS-0713-CCS *Lineside Signalling Layout Driveability Assessment Requirements* provides further guidance about the driveability hazard precursors that influence the train driving task, including the contribution of information shown on lineside operational signs.

G 2.1.7 RSSB's *Taking Safe Decisions* recommends use of the principle of 'hierarchy of hazard controls' in the preferred order of hazard control types, resulting in the most successful, efficient, and cost-effective control of risk. In this hierarchy engineering controls rank above administrative or procedural controls.

G 2.1.8 Signage can have a part to play in supporting identification and successful completion of power changeover (PCO) at the correct location by a driver. There may however be engineered controls that reduce or avoid the need for any positive driver action to carry out the changeover, or which mitigate the effects of any failure to carry out or complete a changeover at the correct location or time. It is also possible

that the characteristics of the location and nature of the changeover mean that a failure to carry out the changeover successfully will not have adverse consequences. It is therefore good practice for transport operators to co-operate to develop and implement a process to assess each proposed changeover. This would include identifying whether controls other than signage are a more effective solution. Signage would therefore only be provided where it has been assessed to be the optimal solution. This assessment would, in particular, consider the guidance that supports this requirement.

G 2.1.9 Engineered controls that might be provided are described in RIS-2713-RST *System Requirements for the Introduction and Operation of Multi- Mode Rolling Stock*.

G 2.1.10 The principal method of identifying to the driver the need for PCO at a particular location is an understanding by the driver of the intended method of operation of the train concerned. This forms a part of the driver's route knowledge and situational awareness. Signage is a risk control measure that can help to support the driver's route knowledge and situational awareness. Signs provide a reminder to drivers that it is necessary to carry out PCO, and as a reassurance that this is being undertaken at the correct location. However, as signs are an administrative control, their effectiveness at mitigating human error is considered to be limited when compared to engineering controls.

G 2.1.11 The extent of provision of signage is influenced by the following:

a) Whether PCO is undertaken when the train is moving (dynamic PCO) or stationary (static PCO).
b) Whether PCO is undertaken manually (MPCo) or automatically (APCo).
c) Whether PCO is required routinely at any given location, or whether this is a temporary requirement, planned or unplanned, including examples such as engineering operations, or diversion via a non-electrified route during perturbation.
d) The potential consequences of PCO not being completed within the limits of the PCO location.
e) The extent and reliability of alternative engineered controls to prevent or reduce the consequences of PCO not being completed as required.

G 2.1.12 If signage is provided which will only require driver response on a limited number of occasions, these signs would only rarely require recognition and reaction by drivers, and would not form a regularly exercised element of route knowledge, with a potential for an incorrect response and hazardous consequences. Additional arrangements not wholly reliant on signage are likely to represent a better option.

G 2.1.13 Examples of signage which will only require driver response on a limited number of occasions would include:

a) A non-electrified connection between running lines, that during times of perturbation would only be used infrequently.
b) The access to an unwired loop or siding.
c) Access to a diversionary route that is seldom used for this purpose and over which drivers might not have route knowledge.

G 2.1.14 It is good practice to consider as an alternative to providing signage to support dynamic PCO at such locations that a static PCO is undertaken at a previous location when the abnormal routing is necessary. If the previous location is some distance away from the PCO location, it might not be suitable, for example another PCO location might intervene, or a change of driver take place.

G 2.1.15 It is good practice to consider the operational process relating to the issue of short-notice diversion which may require unexpected PCO so that this can be managed in a way that reduces the possibility of any PCO errors with adverse consequences.

G 2.1.16 The consequences of PCO not being completed as intended include the following:

a) Damage to rolling stock or infrastructure, with potential harm to trackside staff, passengers or members of the public near the line if PCO from an overhead contact line (OCL) system is completed too late.
b) Damage to rolling stock or infrastructure, with potential harm to trackside staff, passengers or members of the public near the line if PCO to an OCL system is begun too soon or too late.
c) Damage to rolling stock due to gauging issues with potential harm to trackside staff, passengers or members of the public near the line if PCO from a conductor rail system requiring collector shoes to be retracted has been completed too late.
d) Loss of traction power if PCO has not been completed until after the previous source is no longer available, the consequences of which are principally performance related.
e) Depletion of a self-powered source of energy if PCO has not taken place at the intended location, with direct performance consequences, but which can affect system risk through stranding a train. This can have consequences such as an adverse passenger environment, potential self-evacuation and the knock-on effects of service disruption such as a build-up of passengers at stations or adverse signal aspects.
f) Inability to maintain the planned speeds or timings of the train if continuing to operate using an energy source that provides insufficient traction power with direct performance consequences, and similar knock-on effects through an element of service disruption.
g) Operation in a self-powered mode that is inappropriate at a subsequent location for environmental considerations such as air pollution or noise.
h) If PCO is planned to assist in power supply management, the intended advantages might not be achieved.

G 2.1.17 The importance of providing an administrative control such as a sign is increased when there is greater responsibility on the driver to carry out the changeover task correctly as a safety responsibility that reduces or mitigates risk. In this case, providing signage might contribute to correct performance of the task. However, overloading drivers with unnecessary information might be equally undesirable and it is good practice to consider as part of the assessment how to avoid this.

G 2.1.18 The effectiveness of signs is dependent on familiarity and the frequency with which drivers respond to them to carry out PCO.

G 2.1.19 Reliance on correct response to a lineside sign is, however, likely to be less effective than any engineered control measures at a PCO location, and vulnerable to driver error, examples of which would include:

a) Loss of situational awareness resulting in the driver failing to appreciate that action is necessary.
b) Failure to identify and react to signage.
c) Premature or delayed reaction to the indications resulting in PCO being attempted too early or too late for successful completion.
d) Driver distraction or a higher than expected workload on the day at PCO locations, which are designed to be at locations where workload is low, resulting in a failure to respond correctly.
e) Habituation leading to a failure to recognise that an alternative action is required to that normally expected at the location concerned.
f) Misinterpretation leading to the incorrect action being taken.

G 2.1.20 Identification of the type of train, or route to which the changeover applies by means of signage is intended to make clear that PCO is necessary at a location. It can also make it clear that it does not apply to other trains, for example those that will complete their journey without the need for PCO.

G 2.1.21 For dynamic PCO, the use of symbols for main signage rather than text is preferable because of the difficulty of reading and interpreting text whilst travelling at speed, although text can be acceptable on supplementary signage such as routing information.

G 2.1.22 The process for designing, trialling and introducing any new operational sign that is necessary because of the contents of this standard is the industry agreed and endorsed process to introduce a new lineside operational sign or a new application of an existing lineside operational sign that is described in RIS-0733-CCS *Lineside operational signs.*

2.2 Manual power changeover (MPCo)

2.2.1 A 'warning of traction system changeover' sign (AJ04) shall be provided on the approach to the location where dynamic MPCo is to take place, positioned at the start of the preparation zone referred to in RIS-2713-RST *System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock.*

2.2.2 At the location where the changeover process is to be initiated, referred to in RIS-2713-RST *System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock* as the start of the changeover zone, the following signs indicating the changeover required to the new energy source shall be provided:

a) For changeover from an overhead contact line (OCL) system, a sign based on AK206 showing the new energy source.
b) For any other changeover, a sign indicating the new energy source (AJ07 or AJ08)

2.2.3 At the location by which the changeover from a contact line system should have been completed and the current collectors should have been retracted, a sign (AJ03 or AJ08) shall be provided.

2.2.4 If the PCO being carried out involves changing to use of an OCL system, and a delayed changeover would result in a pantograph being raised at a location where the OCL is not compatible with this, a 'Do not raise pantograph sign' (AJ09) shall be provided.

Rationale

G 2.2.5 Where MPCo applies, providing the AJ04 sign will help to draw the attention of the driver to the need to start to take any necessary action in preparation for the changeover.

G 2.2.6 Provision of a sign indicating the need to initiate PCO will assist the driver's own understanding of when to carry out the action. It will also assist in the changeover being carried out at the correct location.

G 2.2.7 A changeover from a contact line system to another energy source requires the current collectors to be retracted before passing beyond the limits of a changeover zone. The provision of a sign indicates the location by which this should have been done.

G 2.2.8 If the raising of the pantograph at normal speed on a line equipped with an OCL system outside the limits of the PCO location could lead to damage or harm, the provision of a sign to indicate that this should not be attempted should reduce the likelihood of this consequence occurring. This incompatibility could be as a result of the type of rolling stock or the type of OCL and might be as a result of:

a) OCL features such as contact wire height, lateral offset, overlaps, presence and type of a neutral section or physical discontinuity, or the OCL being of a 'tramway' type.
b) The presence of cross-overs or junctions.
c) The presence of other infrastructure features such as overbridges, tunnels or level crossings.

G 2.2.9 Apart from PCO to an OCL system, there are unlikely to be any hazards associated with delayed changeover and provision of a sign to indicate PCO should no longer be attempted would be of limited value.

Guidance

G 2.2.10 A summary of the signs that are appropriate at the start and end of the changeover zone appears in Appendix B.

G 2.2.11 The preparation zone is the portion of line where the driver is preparing to initiate PCO.

G 2.2.12 The changeover zone is the portion of line within a PCO location on which PCO is performed.

G 2.2.13 It is good practice where there is a requirement for a sign AJ03, AJ07 or AJ08 to be provided, which would be located before reaching a junction signal, to provide a second sign after the junction signal on the route to which PCO would apply to indicate the new energy source.

2.3 Automatic power changeover (APCo)

2.3.1 Signage at an APCo location shall be provided only to the extent necessary to support the operation.

Rationale

G 2.3.2 If APCo is in operation at a PCO location, the changeover will normally take place at the correct position without being initiated by the driver.

Guidance

G 2.3.3 Provision of an AJ04 sign acts as a reminder to the driver of the approach to a location where APCo might take place and that it might therefore be necessary to take action if the intended changeover does not take place.

G 2.3.4 At the location by which the changeover should have been completed, there can be value in the provision of a sign indicating the action that should have been carried out to achieve this, such as AJ03.

G 2.3.5 Provision of a sign at the end of the changeover zone provides a positional reference point for the driver to know when APCo should have completed the process, which may be of assistance at a location where the PCO is not one encountered routinely.

G 2.3.6 If the PCO being carried out is to changeover to use of an OCL system, and a delayed changeover would result in a pantograph being raised at a location where the OCL is not compatible with the raising of a pantograph, it is good practice to consider the provision of a sign AJ09.

G 2.3.7 Examples of alternative controls that may prevent consequences from a failed PCO include:

a) Infrastructure-based or geo-positioning applications that will intervene to complete a process such as lowering a pantograph when this does not take place at the required location.
b) The existence of a sufficient length of OCL equipment beyond the PCO location to permit manual intervention to take place.

G 2.3.8 The need for signage could depend on the integrity of the APCo system, having considered degraded conditions of:

a) trackside equipment affecting all trains
b) trainborne equipment that affects only one or a limited number of trains.

G 2.3.9 Appendix B of RIS-2713-RST *System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock* provides guidance to inform considerations about the use of automation in multi-mode system operations.

G 2.3.10 Provision of an unnecessarily large number of signs may:

a) detract from their effectiveness
b) detract from the effectiveness of any other lineside signs in the vicinity
c) adversely affect driveability considerations at that location.

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G 2.3.11 The extent of signs provided will have implications of initial and maintenance costs and the resultant increased exposure to trackside risk.

G 2.3.12 It is good practice where there is a requirement for a sign AJ03, AJ07 or AJ08 to be provided, which would be located before reaching a junction signal, to provide a second sign after the junction signal on the route to which PCO would apply to indicate the new energy source.

2.4 Locations of multiple PCO

2.4.1 At a location where different combinations of changeover mode take place, but where it has been determined that engineered controls are not a reasonably practicable option, whenever possible a single set of signage shall be provided that meets any variation in requirements.

Rationale

G 2.4.2 If different types of traction are required to carry out changeovers at the same location, provision of a single sign at the earliest commencement and termination limits of the changeover zone, as agreed by the railway undertakings concerned will provide a more easily driveable indication to drivers with less potential for error than separate signs for each changeover.

G 2.4.3 Indication by separate signage of each changeover which would result in similar signs being provided in close proximity, would make identification and reaction to the correct one being difficult for drivers.

Guidance

G 2.4.4 RIS-2713-RST *System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock* recommends consideration of other PCO requirements when designing a PCO location.

G 2.4.5 To avoid PCO locations overlapping one another, or being in close proximity, the amalgamation of two or more into a single PCO location provides a better solution.

G 2.4.6 Providing a single set of signs caters for the most restrictive limits of the changeover zone, although this may be less than optimal for different types of train.

G 2.4.7 Where PCO to different modes takes place at the same location, a method of indicating this might be that the AK206 signs shows more than one alternative, and by provision of appropriate signs at the the end of the changeover zone.

2.5 Supplementary routing information

2.5.1 Where signage is used it shall be supplemented by additional signs to identify the route to which a PCO applies when the requirement to PCO does not apply to every route.

2.5.2 An indication of applicable route shall be identified by directional arrows, or text relating to geographical direction.

Rationale

G 2.5.3 When it is necessary to provide supplementary routing information, presentation in a consistent and comprehensible manner will assist recognition, interpretation and driveability.

Guidance

G 2.5.4 Appendix A provides details of the supplementary signage that can be provided.

G 2.5.5 A supplementary sign can be provided when necessary to indicate that PCO applies to routes except that identified by the sign.

G 2.5.6 Where a supplementary sign uses text to indicate relevant geographical directions abbreviations can be used to aid legibility, provided the abbreviations can be readily interpreted by drivers.

G 2.5.7 It is good practice for the location of the supplementary signage to allow it to be visible to the driver after receiving a signalled indication of route.

G 2.5.8 If a technological solution would allow signage to be presented only to applicable trains this would be a better option.

2.6 Alterations to signage arrangements

2.6.1 The provision of signage at a PCO location shall be reviewed and altered as necessary when there is a change in the operational requirements.

Rationale

G 2.6.2 Signage provision is based on the operational requirements at a PCO location and may need to be altered in the event of a change in the operational requirements. This is to make sure that it remains fit for purpose in preventing any increased potential for adverse consequences.

Guidance

G 2.6.3 Examples of changes that could lead to a review of the arrangements include the following:

a) The introduction of a new type of train undertaking PCO at the location concerned.
b) Introduction of multi-mode trains over an additional route at a junction location.
c) An additional type of PCO being introduced, for example PCO to self-powered mode as well as an existing PCO to an external power source.
d) A change in the nature of PCO such as MPCo to APCo.
e) Changes to PCO location or zones within it.

2.7 Static PCO

2.7.1 If PCO is undertaken whilst a train is stationary, a sign shall be provided to the extent necessary to support the operation.

2.7.2 The sign shall identify the type of train to which it is relevant and the power mode that applies on the forward journey.

2.7.3 The sign shall be positioned so that it is visible to the driver and can be read and interpreted from the normal stopping position of the train concerned, which may require additional signs where the same train is operated in formations of varying length.

2.7.4 When any signs are to be positioned on station platforms, their provision shall consider whether their location or size may result in obscuring or detracting from the significance of any other lineside signs in the vicinity.

2.7.5 If static PCO is to take place at other than a station, transport operators shall consider whether these arrangements are applicable or whether an alternative solution is necessary.

Rationale

G 2.7.6 Clearly showing which trains the PCO applies to will reduce the likelihood of misinterpretation of what is required to take place.

G 2.7.7 Provision of a sign that is easily visible and interpreted will assist in the PCO being correctly carried out.

G 2.7.8 Any signs located on a station platform could compete for attention with other signs and information displays such as car stop markers.

G 2.7.9 A sign associated with PCO might be of sufficiently large size to obscure visibility of other important information such as signal aspects if the sign were to be inappropriately positioned.

Guidance

G 2.7.10 Additional actions by the driver might be necessary before arriving at the PCO location, such as to prepare rolling stock traction equipment for use after the static PCO. If this is the case, consideration can be given to the provision of a warning of traction system changeover sign (AJ04) on the approach to the static PCO location.

G 2.7.11 As the correct completion of the PCO is reliant on the driver reacting correctly, it is good practice to provide as a reminder a sign such as AJ03 before reaching the end of any safety zone associated with the PCO location. Although PCO will be undertaken while static at a station platform there are possibilities of driver oversight or distraction, hence the AJ03 sign at a subsequent location can be helpful.

G 2.7.12 It is good practice to use signs at the PCO location that are based on the AK206 sign. If an alternative sign is proposed, the process for developing and introducing new signs and existing signs for new purposes is set out in RIS-0733-CCS Lineside Operational Signs. Driveability and comprehension are assisted by consistency of signage throughout a journey.

G 2.7.13 If more than one static PCO takes place at the same location, it may be necessary to consider the positioning of different AK206 signs so that visibility and readability of one is not affected by another.

G 2.7.14 Signs located on a station platform can incorporate details that relate only to specified classes of train or routes.

G 2.7.15 A collaborative approach will assist in determining the most suitable solution in relation to provision of signage on station platforms.

G 2.7.16 The requirements and guidance are primarily based on the assumption that the PCO location is at a station, and if static PCO is performed at any other location the requirements and guidance relating to dynamic PCO are likely to be more relevant.

2.8 Temporary PCO locations

2.8.1 When it is necessary to pass over a portion of normally-electrified line with lowered pantographs using the momentum of the train or an alternative power mode, this shall be regarded as a temporary PCO location.

2.8.2 If trains are to pass the location at no more than 20 mph (30 km/h), signs shall be provided if it is considered to be difficult for the driver to identify the location. The signs to be provided are:

a) Lower pantograph (AJ13) at the location where the pantograph must be lowered, or the changeover made to an alternative power mode.
b) Raise pantograph (AJ14) at the location where the pantograph can again be raised or the train can change back to the overhead contact line supply.

2.8.3 If trains are to pass the location at up to permissible speed, signs shall always be provided as follows:

a) Advance lower pantograph (AJ12) located on the approach to the temporary changeover location.
b) Lower pantograph (AJ13) at the location where the pantograph must be lowered, or the changeover made to an alternative energy source
c) Raise pantograph (AJ14) at the location where the pantograph can again be raised or the train can change back to the OCL supply.
d) Do not raise pantograph (AJ15) before reaching a portion of line where the OCL system is not compatible with raising a pantograph.

2.8.4 If the temporary PCO location is located close to a permanent PCO location, there shall be systems in place to:

a) avoid any confusion as to what is required.
b) prevent changeover being attempted where it would not be the correct action, for example in view of the defect or damage.

Rationale

G 2.8.5 When trains are to pass at no more than 20 mph (30 km/h), the required action and locations might be clearly explained to the driver by verbal instruction, but if not then provision of signage will assist in the driver acting as intended.

G 2.8.6 If trains are to pass under their own momentum at no more than 20 mph (30 km/h), this process would apply only over a short distance, but if changing over to an alternative power mode, this could be introduced for a longer distance.

G 2.8.7 Where trains are to pass the temporary changeover location at a greater speed, the provision of an advance indication will assist the driver to be prepared to carry out the changeover at the correct location.

G 2.8.8 If the raising of the pantograph at normal speed outside the limits of the PCO location can lead to damage or harm, the provision of a sign to indicate where raising of the pantograph should not be attempted will help to avoid this consequence occurring. This incompatibility might be as a result of, for example:

a) OCL features such as contact wire height, lateral offset, overlaps, presence and type of a neutral section or physical discontinuity.
b) The presence of cross-overs or junctions.
c) The presence of other infrastructure features such as overbridges, tunnels or level crossings.

G 2.8.9 If a temporary PCO location is established close to a permanent PCO location, there is a possibility of driver confusion as to the nature or location of the changeover required. In the case of APCo, PCO could be initiated which is not appropriate because the damage or defect requires different actions to be undertaken.

Guidance

G 2.8.10 Temporary PCO might be necessary, for example, as a result of defects or damage affecting the OCL equipment.

G 2.8.11 RIS-2713-RST *System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock* gives requirements and guidance on positioning of PCO locations which could be used in determining the positioning of temporary PCO locations.

G 2.8.12 Where a temporary PCO location is necessary in the vicinity of a permanent PCO location, the alternative measures considered could include:

a) Temporary disabling of APCo on any train required to pass.
b) Obscuring signage provided in connection with the PCO location to indicate that the normal arrangements do not apply.
c) Undertaking static PCO at a location before reaching the affected portion of line.

G 2.8.13 It would be particularly important to obscure any signage indicating that the pantograph is to be raised.

G 2.8.14 It is good practice for signage provided for temporary purposes to be visually distinctive from permanent signage. The use of yellow and black as a means of distinguishing temporary signage is an established practice in relation to temporary speed restrictions and emergency special working.

G 2.8.15 Whilst the content of this clause is based on OCL systems, there could be some merit in considering the development of a similar arrangement on lines electrified by a conductor rail system.

Appendices

Appendix A Provision of supplementary routing information

A.1 **Note:** The content of the Appendix is required by clause 2.5.1.

At power changeover (PCO) locations, the requirement for PCO might apply only to certain possible routings beyond the PCO location. Signage provided in connection with PCO might have to be supplemented by additional signs to identify the routes to which they apply. The requirements for such signs are shown in the table below.

A.2 Supplementary signage shall be provided in association with the signs shown below in line with the following principles:

a) At an APCo location, or an MPCo location where engineering controls, both trainborne or lineside can be relied upon to operate when necessary, only with the sign indicating the action that should have been carried out to achieve PCO, such as AJ03.
b) At an MPCo location without MPCo controls that can be relied upon, with all signs relating to the changeover.

A.3 In determining whether a diverging route is considered as to the left or right, the same direction as indicated by other means for the junction shall be used unless this would lead to an ambiguous indication. Examples of those indications include associated junction indicators, or directional arrows on permissible speed indicators,

A.4 The term 'train class' refers to the class identifier, such as 80x.

Route on which changeover required	Supplementary sign to be provided
The only route ahead, for all trains	None
The only route ahead, for certain trains	Train class indication
All routes ahead, for all trains	None
All routes ahead, for certain trains	Train class indication
One or more diverging routes in the same direction, for all trains	Directional arrow
One or more diverging routes in the same direction, for certain trains	Directional arrow and train class indication
A specific diverging route, for all trains	Route identifier
A specific diverging route, for certain trains	Route identifier and train class indication
PCO is not required on a specific route, for all trains	Crossed through route identifier
PCO is not required on a specific route for certain trains	Crossed through route identifier and train class identifier.

Table 1: Supplementary signage provision

Appendix B Signs

B.1 Application of signs

Guidance

G B.1.1 The design requirements for each of these signs are shown in the RSSB Standards Catalogue under the tab 'Signs', and the signs are listed in the Appendix to RIS-0733-CCS *Lineside Operational Signs*. The table below indicates the types of traction changeover to which they apply.

G B.1.2 This standard contains further detail on the provision of these signs in different situations.

G B.1.3 Not all these signs are at present published in the catalogue.

Sign ID	Name	Applicable changeovers
AJ03	Lower pantograph	Dynamic PCO from overhead supply to self-powered or conductor rail.
AJ04	Warning of traction system changeover	Dynamic PCO between any power modes.
AJ07 *(new sign)*	Changeover to overhead electric traction	Dynamic or static MPCo from self-powered or conductor rail to overhead supply.
AJ08 *(new sign)*	Changeover to self-powered	Dynamic MPCo from conductor rail to self-powered or one self-powered mode to another.
AJ09 *(new sign)*	Do not raise pantograph	Dynamic MPCo from self-powered or conductor rail to overhead supply.
AJ10 *(new sign)*	Directional arrows	Dynamic PCO between any power modes.
AJ11 *(new sign)*	Indication of route	Dynamic PCO between any power modes. Static MPCo between any power modes.
AK206	Train class specific instruction	Static or dynamic MPCo between any power modes.
AJ12 *(new sign)*	Advance lower pantograph	Temporary PCO from overhead supply to 'coasting' or self-powered.
AJ13 *(new sign)*	Lower pantograph	Temporary PCO from overhead supply to 'coasting' or self-powered.
AJ14 *(new sign)*	Raise pantograph	Temporary PCO from overhead supply to 'coasting' or self-powered.

Sign ID	Name	Applicable changeovers
AJ15 *(new sign)*	Do not raise pantograph	Temporary PCO from 'coasting' or self-powered to overhead supply.

Table 2: Application of signs

Definitions

automatic PCO (APCo)	Power changeover that is initiated by the rolling stock without intervention by the driver.
changeover zone	Section of track within a PCO location on which PCO is performed.
class identifier	The initial two digits of a locomotive number (for example 60) or the initial three digits of a multiple unit set identification number (for example 465).
contact line system	The system that distributes the electrical energy to the trains running on the route and transmits it to the trains by means of current collectors. Source: *ENE NTSN*
current collector	Equipment fitted to the vehicle and intended to collect current from a contact wire or conductor rail. Source: *IEC 60050-811, definition 811-32-01*
diverging route	Any signalled line beyond a diverging junction that is not designated as the principal route. This includes routes on which only a shunt MA applies.
driveability	The ease and reliability that train drivers are able to perform train operations in accordance with rules and procedures, throughout the range of operational and ambient conditions applicable to each train, within the operational context and while performing typical required duties.
dynamic PCO	Power changeover that is performed whilst the rolling stock is on the move.
infrastructure manager (IM)	Has the meaning given to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended), but is limited to those infrastructure managers who hold a safety authorisation issued in respect of the mainline railway. Source: *ROGS*
manual PCO (MPCo)	Power changeover that is initiated by the train driver.
multi-mode rolling stock	Rolling stock with more than one source of traction energy, and with at least one of those sources being external to the train, that is an ac or dc contact line.
overhead contact line (OCL)	Contact line placed above (or beside) the upper limit of the rail vehicle gauge and supplying vehicles with electric energy through roof-mounted current collection equipment. Sources: *IEV 811-33-02, ENE NTSN*
	Note: Where this includes, in addition to all current-collecting conductors, the following elements: reinforcing feeders; cross-track feeders; disconnectors; section insulators; overvoltage protection devices; supports that are not insulated from the conductors; insulators connected to live parts; along-track feeders; conductors connected

	permanently to the contact line for supply of other electrical equipment; earth wires and return conductors.
PCO location	Section of track designated for undertaking PCO.
power changeover (PCO)	The process by which multi-mode rolling stock changes from one source of traction energy to another.
preparation zone	Section of track within a PCO location that provides time for the driver to prepare for a PCO operation.
railway undertaking (RU)	Has the meaning given to the term 'transport undertaking' in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended, but is limited to any private or public undertaking the principal business of which is to provide rail transport services for goods and/or passengers, with a requirement that the undertaking must ensure traction. Source*: ROGS*
rolling stock	Rail vehicle and / or formation of rail vehicles. Source: EN 17343:2020
route knowledge	The information required to predict, identify and interpret route-specific cues to complete an operational railway task safely and effectively.
safety zone	Section of track within a PCO location that provides time for a defined action to be performed and completed in the event of a failure to complete PCO within the changeover zone.
static PCO	Power changeover that is performed whilst the rolling stock is stationary.
train	An operational formation consisting of one or more units. A unit may be composed of several 'vehicles'. Sources: Directive 2008/57/EC, Article 2(c); LOC&PAS NTSN, 2.2.1 **Note:** In GB application, an operational formation may consist of locomotives, wagons, coaches, multiple units or a single fixed formation unit and any combination thereof
transport operator	An infrastructure manager or railway undertaking.
unit	A permanently coupled group of vehicles. A unit may also be a single vehicle.

References

The Standards catalogue gives the current issue number and status of documents published by RSSB: http://www.rssb.co.uk/railway-group-standards.

RGSC 01	Railway Group Standards Code
RGSC 02	Standards Manual

Documents referenced in the text

Railway Group Standards

RIS-2713-RST	System Requirements for the Introduction and Operation of Multi-Mode Rolling Stock
RIS-0713-CCS	Lineside Signalling Layout Driveability Assessment Requirements
RIS-0733-CCS	Lineside Operational Signs

RSSB documents

-	Taking Safe Decisions

Other references

ENE NTSN	Energy National Technical Specification Notice
LOC and PAS NTSN	Rolling Stock Locomotives and Passenger Rolling Stock National Technical Specification Notice
IEC 60050-811	International Electrotechnical Vocabulary (IEV) - Part 811: Electric traction
IEV 811-33-02	International Electrotechnical Vocabulary
BS EN 17343 2020	Railway applications. General terms and definitions

Other relevant documents