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Issue:	3
Date:	05/09/2015
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Module

Robust Train Protection

Endorsement and Authorisation

For endorsement, authorisation and issue record of this document, please refer to the SSI Applications Manual Contents, NR/L2/SIG/17002.

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User information

This Network Rail standard contains colour-coding according to the following Red–Amber–Green classification.

Red requirements – No variations, could stop the railway

- **Red requirements shall** always be complied with and achieved.
- Red requirements shall be presented in a red box **with the word “shall” or expressed as a direct instruction**.
- Accountability for the efficacy of red requirements lies with the Professional Head/Standard Owner.
- Red requirements are monitored for compliance.
- Corrective actions shall be enforced if deviations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Amber requirements – Controlled variations, approved risk analysis and mitigation

- **Amber requirements shall** be complied with unless variation has been approved in advance.
- Amber requirements shall be presented with an amber sidebar **and with the word “shall” or expressed as a direct instruction**.
- Accountability for the efficacy of these requirements lies with the Professional Head/Standard Owner, or their nominated Delegated Authority.
- Amber requirements are monitored for compliance.
- Variations **may** be permitted. Variations are approved by the Standard Owner or through existing Delegated Authority arrangements.
- Corrective actions shall be enforced if **non-approved** variations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Green – Guidance

- Guidance is based on good practice. Guidance represents supporting information to help achieve **Red** and **Amber** requirements.
- Guidance shall be presented with a dotted green sidebar **and with the word “should” (usually in notes) or as a direct instruction**.
- Guidance is **not mandatory** and is not monitored for compliance.
- Alternative solutions may be used. Alternative solutions do not need to be formally approved.
- Decisions made by a competent person to use alternative solutions should be backed up by appropriate evidence or documentation.

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Issue record

Issue	Date	Comments
2	Dec 2010	2 nd Issue
3	05/09/2015	Clause 5.2.3 amended to prove foul track circuits clear in aspect controls when swinging overlaps

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 06/12/2015.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 3 (Option Selection) to continue to comply with the issue of any relevant Network Rail standards current when GRIP Stage 3 was completed and not to comply with requirements contained herein, unless stipulated otherwise in the scope of this standard.

Reference documentation

[RT/E/G/00028](#) "General Guidance on Train Protection & the Provision of Signalling", Issue 1, December 2003

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1 Introduction

This document is based on [NR/GN/SIG/00028](#), plus guidance on its implementation and acceptable variations given to the SSI Signalling Principles Group by Charles Weightman, Network Rail Principles Signal Engineer North. Within [SSI8003-85](#), the following subjects are covered:

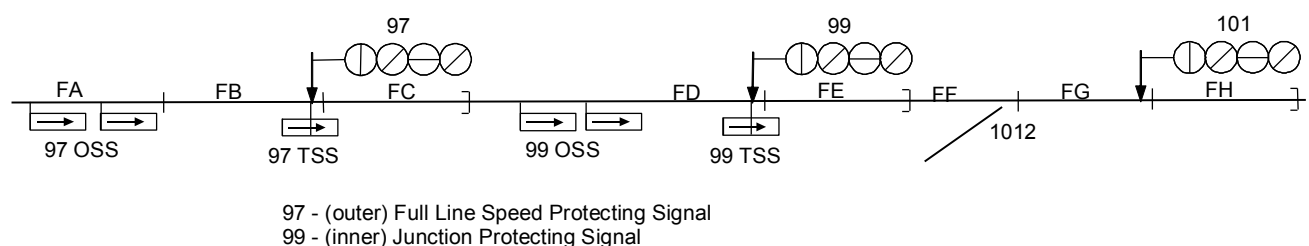
- Section 2 Two Reds Rule
- Section 3 Hard Calling of Points beyond the Standard Overlap
- Section 4 Soft Calling of Points beyond the Standard Overlap
- Section 5 Point Flank at Single Ended Points
- Section 6 Overrun Detection

For TPWS related matters, such as TPWS+ and Approach Release Relief, see [SSI8003-81](#).

2 Two Reds Rule

2.1 Principles

The 'Two Reds Rule' is detailed in [NR/GN/SIG/00028](#) Section 2 Clauses 2.4 and 2.14.1 to 2.14.4 and Section 5. This rule confirms that there will be two signals at danger between an approaching train and the potential point of conflict. This point of conflict could be head-on or at a diamond crossing, where the closing speed will potentially be above a defined speed. Where only converging conflicts are being considered, the application of this rule may still be appropriate under some circumstances, particularly where one of the moves is at high speed. (See [NR/GN/SIG/00028](#) for further details - the speeds in the current issue of this document were under review at the time of preparing [SSI8003-85](#).)



2.1.1 Dead Two Reds Rule

The simplest method of providing controls for the Two Reds Rule is to not allow the (outer) Full Linespeed Protecting Signal to display a proceed aspect until the (inner) Junction Protecting Signal is displaying a proceed aspect (i.e. standard preceding controls). This method is simple and easy to apply but will be too restrictive for most areas, as following trains would be subject to delay.

2.1.2 Conditional Two Reds Rule

A more flexible method is to allow the (outer) Full Linespeed Protecting Signal to display a proceed aspect when the train has been 'brought under control' (a) or when the route is set (and approach locked) from the (inner) Junction Protecting Signal (b). TPWS is provided at the (outer) Full Linespeed Protecting Signal for this control.

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- (a) To prove the train has been brought under control, the signal will only show a proceed aspect when the approaching train has passed the OSS of the (outer) Full Linespeed Protecting Signal (which it shall have done at less than the set speed, to have avoided an intervention).
- (b) Although a route may be set from the (inner) Junction Protecting Signal the signal may not be approach locked, because the signal may not be showing a proceed aspect (due to a train in route or approach release requirements). Under these circumstances it would be possible to cancel the route and immediately set a conflicting route. Because a train could be approaching the (outer) Full Linespeed Protecting Signal with an unrestricted aspect, the (inner) Junction Protecting Signal shall be approach locked.

This is achieved by controlling the signal to become approach locked when the inner route is set and the aspect controls are satisfied except for train detection in the line of route from the inner signal's overlap onwards (this variation on [NR/GN/SIG/00028](#) Clause 2.14.1 agreed by Network Rail). Thus this approach locking is applied just before it may be required for the clearing of the (outer) Full Linespeed Protecting Signal. This approach locking is applied early to all routes from an inner signal every time that the inner signal is in the process of clearing (this interpretation of [NR/GN/SIG/00028](#) Clause 2.14.1 agreed by Network Rail).

This method prevents the outer signal clearing to an unrestricted proceed aspect until the inner route is established, with all points detected. This has the benefit of confirming that the safe overrun is established, and also allows the Signaller to cancel and re-stroke the route, if points fail to detect in their correct position, before applying approach locking.

Although not an SSI-specific problem, it should be noted that where approach locking is applied as early as this, the signal(s) immediately ahead of the (inner) Junction Protecting Signal shall not have look-back TORR, i.e. an alternative form of TORR shall be used. With look-back TORR, if the previous train has just cleared the signal ahead, with the approach locking applied early a legitimately approaching train will no longer be "hidden" as usual from the look-back by the intervening (inner) Junction Protecting Signal free of approach locking, thus TORR will fail.

Where the two reds rule is applied to existing data, it is necessary to confirm that the step-up conditions of affected warning-class routes do not test that the warning signal is free of approach locking. This test is no longer required by [SSI8003-63](#). If the test were to be left in place, the two reds rule requirement to apply approach locking as soon as the route is set, would prevent the warning-class route from ever stepping up.

2.2 Data for Dead Two Reds Rule

2.2.1 OPT File – (Outer) Full Linespeed Protecting Signal]

The ACD data for signal 97 includes a test to prove signal 99 is displaying a proceed aspect. The additional data is shown in bold.

```
if S97 set stick
    < Aspect Controls >
    S99 set lp+<b>r</b>
\
```

. / ACD

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2.2.2 OPT File – (Inner) Junction Protecting Signal

If comprehensive approach locking is applied to this signal then the look-back has to go back an additional signal section because replacing signal 99 will also replace signal 97, therefore potentially a driver will see a green aspect change to a cautionary aspect an additional signal section in rear.

2.3 Data for Conditional Two Reds Rule

2.3.1 Identities

An additional latch in the FLG file is allocated for the (inner) Junction Protecting Signal. This Aspect Control Special latch is used to store all the aspect controls except for train detection in line of route beyond the overlap of this signal and any approach controls, and is named L<Signal number>ACZ, e.g. L99ACZ.

2.3.2 OPT File – (Inner) Junction Protecting Signal

The approach locking is applied when all the aspect controls are satisfied except train detection in the line of route beyond the (inner) Junction Protecting Signal's overlap. Note that the control tables shall indicate this early application of approach locking.

In the OPT file, to achieve this early application of approach locking, the following changes (shown in **bold>**) have to be made to the Output Telegram data for the (inner) Junction Protecting Signal. For all routes, the test data that is normally present in the ACD data section, apart from that which proves train detection in line of route beyond overlap of this signal, is moved to the RSU data section. Tests have to be added to replicate the two tests that the program carries out automatically in the ACD section. The result of these data tests is stored in the Aspect Control Special latch (L99ACZ).

In RSU data:

```
if S99 set stick+asdis , S99 clear bpull
    TFE c
    P1012 cdn
    S101 set lp
then L99ACZ s
else L99ACZ xs
\
<Other RSU data> . / RSU
```

In the ACD data, a test on the Aspect Control Special latch set proves that the tests moved to the RSU data section were successful. The remaining tests for track sections clear, i.e. those in the line of route beyond the overlap of the inner signal, are also present.

```
if L99ACZ s
    TFF c , TFG c , TFH c
\
. / ACD
```

If delayed aspect replacement is required for a route of this signal, then the data shown above has to be further changed. The full usual data associated with the delayed aspect replacement feature is included in ACD data, including any associated tests on the track sections in the overlap and the signal stick. In RSU

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data, the data is as shown above, but with the following changes. The 'asdis' and 'stick' tests are separated, and the latter test and any of the overlap track circuit clear tests that are bypassed by the delayed replacement are conditioned by "signal off". This allows the delayed replacement to function in the usual manner whilst maintaining the same functionality of the Aspect Control Special latch.

Thus if last wheel replacement were required to condition out the first two track sections in the route then the RSU and ACD data would become:

```

if S99 set asdis , S99 clear bpull
  ( S99 set stick , TFE c or S99 set <r )
  P1012 cdn
  S101 set lp
then L99ACZ s
else L99ACZ xs
\
<Other RSU data>                                     . / RSU

if L99ACZ s
  ( S99 set stick , TFE c , TFF c or TFD o , TFE o , S99 set <r )
  TFG c , TFH c
\
                                                         . / ACD

```

The approach locking is applied when the route is set and all aspect controls are satisfied except train detection in the line of route beyond the overlap of the inner signal. The data to achieve this (shown in **bold**) is placed in the Output Telegram for the inner signal immediately after the Signal Special.

```

'S99
  R99A s , @R99A
  R99B s , @R99B
  G s 7
$

if S99 set r then G s 3 \                               /S99 TPWS
Dummy

if L99ACZ s
then S99 clear foal
  if S99 set stick then S99 set tisp0 \                 (a)
\

```

- (a) As the approach locking is being applied early, setting the 'tisp' code to zero brings forward the normal program action in [SSI8003-10G](#) Section 1.2.11. (Normally the 'tisp' code is set to zero if the 'stick' and 'ascon' bits are both set.) This confirms that on pulling this signal's entrance button with this signal in 'Auto' mode, its approach locking cannot be released via the 'tisp' code still at '3' from the previous train. The signal stick test is always provided - it confirms that the 'tisp' code is not zeroed once the signal has been passed if this signal is not in 'Auto' mode and has delayed replacement.

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If TPWS Approach Release Relief also applies (see [SSI8003-81](#)) then the approach locking is still applied as early as required by the Conditional Two Reds Rule, not as required by the TPWS Approach Release Relief, thus the above data for both applying the approach locking early and setting the 'tisp' code to zero applies.

If comprehensive approach locking is applied to this signal then the look-back will need to go back an additional signal section as replacing signal 99 will also replace signal 97, therefore potentially a driver will see a green aspect change to a cautionary aspect an additional signal section in rear.

2.3.3 FOP File - Start-up

It is not necessary to unset the Aspect Control Special latch in the FOP file Start-up routine as it will be unset when the RSU data is first processed.

2.3.4 OPT File – (Outer) Full Linespeed Protecting Signal

The (outer) Full Linespeed Protecting Signal will be allowed to display a proceed aspect either:

When the train has been brought under control. This is achieved by proving the train has passed the (outer) Full Linespeed Protecting Signal's OSS,

or

when the route ahead of the (inner) Junction Protecting Signal is set with approach locking applied and aspect controls satisfied except for train detection in line of route beyond overlap of this signal, aspect restriction controls (where applicable) and approach release controls.

The following changes (shown in **bold**) have to be made to the ASD data for the (outer) Full Linespeed Protecting Signal.

```
G s 7 \
if ( TFB o or L99ACZ s )
then S99 seq 4 , G s 7654
    if TFB o then L97TOR1 s \
\
. / ASD
```

The test on the Aspect Control Special latch set inherently confirms that the approach locking has been applied, as the data in Section 2.3.2 clears the 'foal' bit if this latch is set.

2.4 Intervening Interlocking Boundary

For the Dead Two Reds Rule, the data changes required are as shown in Sections 2.2.1 and 2.2.2. The following sections apply only to the Conditional Two Reds Rule only.

2.4.1 Boundary Between Inner and Outer Signals

In this example it is assumed that the boundary is located at the junction of track sections FC and FD.

The OPT file data shown in Section 2.3.4 for the (outer) Full Linespeed Protecting Signal is affected. The condition " L99ACZ s " has to be passed across the Interlocking boundary. It is preferred but not essential that this information is included in the same IDL telegram as the aspect information for the (inner) Junction