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Split Detection of Points

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Applicability

ARTC Hunter Valley

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1.0	30 Jun 20	All	First issue of the document.

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1 Introduction

1.1 Purpose

The purpose of this guideline is to detail the signalling design principles and requirements for the application of split detection of points at crossovers.

Split detection of points provides advantages for maintenance and operation of signalling infrastructure where there is high traffic density that limits access to the tracks for maintenance purposes.

Split detection of points is not always applied and shall be provided on a case-by-case basis based on the operational and maintenance merits.

1.2 Split Detection of Points

The current practice on the ARTC Network is to combine the points detection at each end of the crossover. Under this design philosophy, the loss of detection at either the flank point end or line of route point end replaces the signals on both lines to stop. To achieve this design functionality the point control, detection, locking and indicating functions are common for both ends of the crossover.

Split detection of points separately detects each end of the crossover, and separately input the point detection into the signal aspect control functions. Under this design philosophy, if the flank point end detection fails, movements over the non-failed line of route point end may be allowed under certain conditions without the flank point end being detected.

1.3 Scope

This Guideline covers the principles of split detection of points on the ARTC Hunter Valley Heavy Haul Rail Network. Split detection of points shall only be provided where it is nominated as part of the signalling functional requirements. Split detection of points shall only be applied for computer-based interlocking (CBIs) installations.

1.4 Responsibilities

The Signal Engineer or Engineering Manager (responsible for the signalling infrastructure) is responsible for deciding the need of Split detection of points for a particular project based on operational and maintenance merits.

The Signal Design Manager and the Signal Design Engineer are responsible for the application of the principles detailed within this Guideline.

1.5 Document Owner

The General Manager Technical Standards is the Document Owner. For any query, initial contact to be made at standards@artc.com.au

1.6 Relevant Procedure

This Guideline shall be read in conjunction with ESD-05-01 Common Signal Design Principles, S1-Signalling Locking and Train Dynamics.

1.7 Reference Documents

- ANSG 608 Passing Signals at STOP
- ANPR 743 Manually Operating Hand-throw Electric Points
- ESD-05-01 Common Signal Design Principles, S1-Signalling Locking and Train Dynamics
- SDS 25 Signalling Circuit Design Standards
- ESM-00-02 Failures

1.8 Definitions

The following terms and acronyms are used within this document:

Term or Acronym	Description
ARTC	Australian Rail Track Corporation Ltd.
Crossover	Two turnouts typically providing a path from one running line to another.
'Bob' Protection	The movement of a train over turnout switch blades may cause momentary rolling of the switch blade leading to detection contacts being broken for very short periods. 'Bob' protection provides a 1 second delay to the point detection, to maintain proceed aspects in signals on the adjacent line, during this period.
EOL	Emergency Operations Lock. A mechanically indexed key that releases a hand throw lever on the points machine.
ESML	Emergency Switch Machine Lock. A mechanically indexed key combined with a crank handle that may be used to manually operate a points machine.
Flank Point End	Points which, if traversed by an overrunning train in the facing direction, could direct that train away from a route or overlap that has been set for an authorised train movement i.e. the point ends not in the path of the signal route that is being set or locked.
Line of Route Point End	These are point ends in the path of the signal route that is being set and locked. These are also point ends in the overlap of the signal route being set, located on the same line (typically the first facing point end of a crossover in the overlap).
Flank Track Section	These are track sections (track circuit, axle counter or other train detection device) conditioned by point detection, in the overlap of the signal route that is being set and locked.
Foul Track Section	These are track sections (track circuit, axle counter or other train detection device) which are foul of the path (or overlap) of the signal route that is being set and locked.
Point, Point End, Set of Points	Another term for a turnout or sets of turnouts making up a crossover.
Point Isolation Switch	This is the standard switch that isolates power to individual point motors for a turnout or crossover. Note, at swing nose crossing installations, the point isolation switch isolates the point end motor and swing nose crossing end motor.

Term or Acronym	Description
SPAD	A signal passed at danger (SPAD) is an occurrence where a train passes a signal displaying a stop indication without the authority to do so.
Swing Nose Crossing (SNX)	A type of turnout in which the flangeway at the nose is arranged to open or close according to which way the points are set, to provide a smooth passage for the train wheel.
Split Detection of Points	Where the detection for each end of the crossover is separately detected and separately input into running signals on each line.

2 Principles of Split Detection

For the purposes of this document, the terms EOL and ESML are functionally synonymous and where the text states EOL, it should be understood to be interchangeable with ESML.

The split detection of points shall be designed in accordance with the following principles:

1. Split detection of points shall only be applied to double ended crossovers.
2. Where split detection of points is applied, the signal aspect control function shall prove the line of route point end detection unconditionally and shall prove the flank point end conditional upon the track section over the flank point end.
3. Where split detection of points is applied, a 1 second delay (slow to drop) shall be applied to the NWKR function within the CBI (Microlok) data. The purpose of this delay is to maintain the proceed aspect of any flank route whilst a parallel movement takes place (and bob's the detection) over the other end of the crossover.
4. Protecting home signals shall be set to stop by the removal of the EOL key for the line of route (facing) point end of the crossover.
5. Signals in rear of a home signal which have an overlap extending over the crossover, shall be set to stop by the removal of the EOL key for the line of route (facing) point end of the crossover and also set to stop by the removal of the EOL key for the flank point end, unless the line of route point end set and detected normal.
6. Protecting home signals, shall be restricted to a caution proceed aspect by the removal of the EOL key for the flank point end.
7. Signals in rear of a home signal which have an overlap extending over the crossover, shall be restricted to a caution proceed aspect by the removal of the EOL key for the flank point end.
8. Separate EOL keys shall be provided for each point end motor. For swing nose crossing installations, the A/B ends shall have a separate warding to the C/D ends. The EOL keys shall be housed in the same EOL cabinet.
9. The Phoenix screen display for the crossover shall separately indicate detection status for each point end. Swing nose turnouts shall have a combined indication for the switch blades and the swing nose.
10. Where split detection of points is applied, a detection failure of either end of the crossover shall disable the Phoenix fleeting facility for routes and overlaps over both ends of the points. In addition, upon detection failure of crossovers with split detection, the Network Control Officer shall be notified by a specific 'pop-up' message; the message should convey to the Network Control Officer that hand signalling over the failed end of points will replace any proceed aspect in signals on the adjacent line.

3 Design Guideline for Split Detection

The following sections provide guideline for design of split detection for a computer-based interlocking based on Microlok, NSW practice. The same principles and logic shall also apply when using other types of computer based interlocking.

3.1 Point Control and Detection

The following point functions shall remain common to both ends of points:

- Point control functions: NLR/RLR.
- Point locking and availability functions: WJR/WZR, NWAR/RWAR and NOLR/ROLR.
- Point detected and locked reverse function: RLKPR.

The following point functions shall be separate for each point machine:

- Point detection circuits: NKR/RKR

The following point functions shall be separate for each point end:

- Point detection functions: NWKR/RWKR
- Point detected and locked normal function: NLKPR.
- Point control circuits: NWR/RWR.
- Point isolation circuits: IR & WTJR.
- Point EOL circuits.
- For each point machine, separate NKR/RKR circuits are required. For each point end, separate NWKR/RWKR and NLKPR functions are required. The RLKPR shall remain a common function to both point ends.

All other existing usage of the NLKPR e.g. down proving in the RLKPR function, shall utilise both the ‘A’NLKPR & ‘B’NLKPR functions in series.

The adoption of split detection of points may have implications to existing point sequencing controls.

3.2 Signal Aspects

Detection of points within the signal aspect shall be modified as follows:

1. For routes which set and lock the crossover normal in the line of route, the signal aspect control function shall prove the line of route point end NLKPR unconditionally.
2. For routes which unconditionally lock the crossover normal in the line of route, the signal aspect control function shall prove the foul track section clear on the adjacent line, conditioned by the flank point end NWKR.
3. For routes which set and lock the crossover reverse in the line of route, the signal aspect control function shall prove the common RLKPR unconditionally.
4. For routes which conditionally lock the crossover normal in the overlap, the signal aspect control function shall prove the line of route point end NWKR.

5. For routes which conditionally lock the crossover reverse (in the overlap) the signal aspect control function shall include both line of route point end RWKR and flank point end RWKR.
6. In addition to item 4, overlap foul track sections on the adjacent line shall be proved clear, conditioned by the line of route point end NWKR and flank point end NWKR, in the signal aspect control function.
7. In addition to item to number 5, the overlap track sections on the adjacent line that are not foul, shall be provided clear in the signal aspect control function, conditioned by the line of route point end NWKR.

   In addition to above requirements, signal designer shall consider additional controls based on design risk assessment.

3.3 Phoenix Train Control System - Point Controls and Indications

Point detection indications shall be provided for both ends of a crossover separately. Where a turnout has more than one point motor e.g. swing nose crossing it shall have only one combined detection indication on the Phoenix display.

N.B. The Phoenix/Panel fascia must show all ends of the points on the track display, as well as separate point detection indications.

To simplify Phoenix data preparation, “points free” and “points in transit” (out of correspondence) indications shall also be split for each point end of the crossover. Separate (but functionally identical) WZR functions shall be sent to Phoenix to drive the separate “points free” indications for each point end or combined point end/swing nose. Separate NWKKR & RWKKR functions shall be derived within Phoenix to drive the separate “points in transit” indications. In order to simplify Phoenix data preparation, the normal, centre and reverse point control bits from Phoenix shall be split for each point end or combined point end/swing nose crossing and transmitted separately to the interlocking, where they will be combined.

Control tables shall reflect the additional signal and point controls.

3.4 Point ‘Bob’ Protection

This shall only to be applied to point detection which conditions out foul track sections on adjacent lines; for most scenarios, this is the normal detection. This is achieved by a 1 second delay holding the point detection function from dropping out to protect against a train traversing over the flank point end on the adjacent line and replacing the signal aspect, if the detection momentarily breaks and then re-makes again. The de-energisation of the point detection function shall have a 1 second slow to release capability within the CBI data.

4 Signage and Identification

4.1 Point Indications – Phoenix Screen Display

For crossovers provided with split detection of points, the name of each point end shall be displayed on the Phoenix screen display. For swing nose crossings, the point end is a combined name e.g. “101C\D”. Separate inputs shall be provided for each point end or combined point end\swing nose.

The status of each point end shall be separately displayed on the Phoenix screen. This includes the following indications for each point end or combined point end/swing nose:

- Points Normal / Reverse Detection
- Points in Transit
- Points Free

Figure 1 below shows how a crossover with split detection of points will be represented on the Phoenix TCS panel.

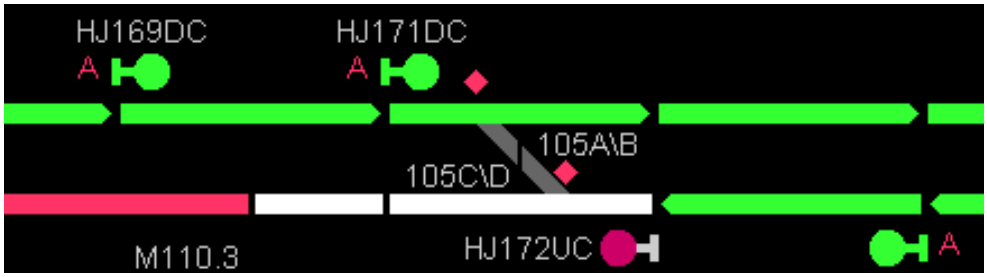

Figure 1: Phoenix Screen showing split detection of points.

4.2 EOL Cabinet Signage

Separate EOL keys shall be provided for each point motor controlling each point end. For swing nose crossing installations (SNX), The A/B ends shall have a separate warding to the C/D ends. The EOL keys shall be housed in the same EOL cabinet.

The EOL cabinet shall be provided with a location track diagram displaying the location and number of the points to which the EOL applies. The track diagram shall have the location of each point and swing nose crossing to which the EOL applies clearly marked and identified by the point ID (i.e. 101A, 101B, 101C, 101D).

The relative position of other points and signals shall also be displayed. Signage shall be provided in the EOL cabinet and on the points to indicate the number of points ends required to be manually operated. See Figure 2 below for an example layout.

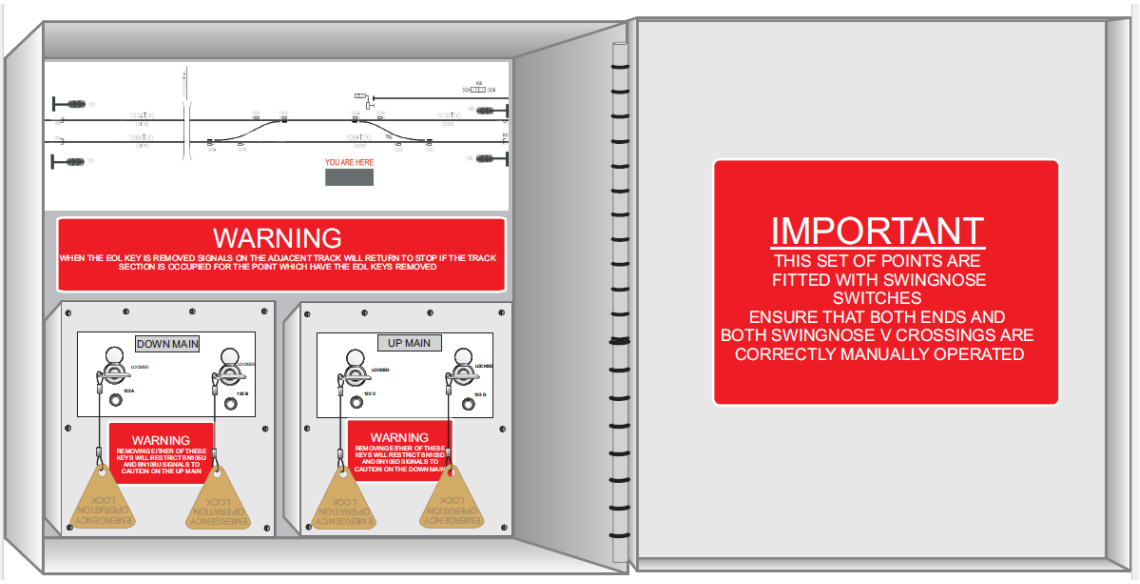

Figure 2: EOL Cabinet and Signage (for a swing nose crossing example)

5 Manual Operation of Split Detection Crossover

5.1 Network controller

5.1.1 SPAD Risk

The following circumstances may result in an increased SPAD risk brought about the implementation of split detection of points:

1. In the event there is a normal detection failure on one end of the crossover i.e. either the A/B or C/D end, the Network Control Officer can clear the home signal over the non-failed end, which will allow normal operations to be maintained on the adjacent line.
2. However, any subsequent track section occupation over the failed point end will replace the protecting signals on the adjacent line to stop. This could be caused by the following scenarios:
    a. The track section over the failed flank point end is occupied either by signal maintainers working on the failed flank point end, or a train detection device equipment failure.
    b. Passage of a train over the failed flank point end under a special proceed authority (SPA).

Under these circumstances the Network Control Officer before authorising any movements past the protecting signal at STOP on the affected line, must ensure no train is approaching signals displaying a proceed aspect on the adjacent line protecting the crossover, or train has been stopped.

5.1.2 Network Rules changes for Split Detection of Points

The following Network Rules have been updated to reflect the changes to operational procedures to minimise the SPAD risks arising from split detection of points:

- ANSG 608 Passing Signals at STOP
- ANPR 743 Manually Operating Hand-throw Electric Points

5.2 Signal Maintenance

With the current EOL and point non-split detection point arrangement, the removal of the EOL will replace the home (protecting) signals on both lines to stop, meaning maintainers will not usually be exposed to live rail traffic during maintenance activities. With the new split detection point and EOL arrangements, the removal of the EOL at the failed (flank) point end points, will not replace the signal at signals reading over the non-failed (line of route) point end to stop, meaning that if the non-failed point end is set and detected normal. As a result, maintainers may be exposed to rail traffic on the operational adjacent line.

As a control measure to protect maintainers whilst maintaining point ends or attending failures, the removal of the EOL at the failed (for a flank) point end points will replace the aspects of the protecting home and signal in rear on the non-failed (adjacent line of route) end to caution (single yellow), thus reducing the speed of approaching trains on the operational line.

Signal Maintainers working on failed point end should be made aware of that signal on adjacent line can go back to Stop if track section over failed point end gets occupied by maintenance work.

Signal Maintainers shall only occupy the track sections in consultation with Network Control Officers.

The requirements for operation of the points for Signals maintenance activities are detailed as below.

1. Network Control Officer to give authority for maintenance and operation of one point end of the crossover.
2. Maintenance staff establish appropriate work on track safety protection.
3. The respective point isolation switch for the point end / swing nose to be maintained, is operated to isolate the point motor.
4. The EOL key for the respective point motor is removed from the lock switch and used to operate the point motor.
5. Signal Maintainer shall return all EOL keys to their lock switches to normal, restore all Isolation Switches and inform the Network Control Officer of the completion of work before leaving the location.