Engineering Guideline
Signals
Design

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POINT RENEWAL SIGNALLING DESIGN AND INSTALLATION GUIDELINE

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Engineering Guideline

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Summary of changes from previous version

Summary of change	Section

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1 Introduction

This guideline is for the signalling design for a renewal of an existing point with a point to current standards.

2 Scope

Signalling functional specification, mechanical layouts, signalling plans & track insulation plans.

2.1 Purpose

Provide guidance on the proper signalling design of railway points.

2.2 Application

Points applicable to railway track that is the responsibility of RailCorp.

3 Reference documents

- SPG 0703 Signalling Documentation and Drawings
- SPG 1588 Point Mechanisms
- ESG 100.14 Signalling Design Principle – Points.
- SPG 0711.9 Like for Like Renewals

4 Terms and definitions

The following definitions apply in this document:

Like For Like

- No point machine type change;
- No rodding type change;
- No points relocation greater than 2 metres from the existing position with no impact on insulated joint or signal positions.
- No point or EOL / ESML index change.

5 General

5.1 Equipment Design & Installation

All signalling rodding and equipment shall be supplied and installed in accordance with RailCorp's design and technical standards and is "type approved" for use on RailCorp infrastructure in accordance with RailCorp Signal Engineering Standards SPG 1588, and ESG 100.14.

Quality checks shall be performed during the manufacturing process.

Where the renewal is completely like for like, use the procedures in SPG 0711.9 Like for Like Renewals.

5.2 Block Joint (GIJ) Location

Block Joints are to be relocated from mains (straight) to point rails i.e. in least used route, wherever practical.

Positioning of GIJ's shall be shown on Track Design documentation and manufactured into the point assembly fabrication process (not field installed). Joint stagger shall be considered in accordance with SPG 0709, the signal design principles and signal engineering guideline EGG 1543.

5.3 Emergency Operation

Access for Emergency Operation (i.e. Access to Crank Handle and Points Machine) is to be considered and provided. Requirements for ESML / EOL is that it is to be in a "Safe Place", but not too close to ensure time delay requirements are met between taking ESML / EOL and operating the points.

Motor point EOLs should be located near the trailing ends, or at equal distance from either end of double facing points. EP points EOLs should be located near the facing ends.

5.4 Advertising

Each change will be reported by producing the Weekly Notice insert for all necessary safeworking, operational and infrastructure change aspects of the Turnout Replacement and submit this draft "Notice" to RailCorp for checking, prior to publishing.

Driver's Diagrams shall be prepared in .CAD, .tif and .pdf formats.

5.5 Points Configuration

The point machine position must be considered to determine if it needs to be mounted on the opposite side to existing mounting location to improve OH&S, access and cabling. The need for backdrives will impact the location.

5.6 Track Circuit Bonding

Bonding shall be provided as per the Track Insulation Plan, upgraded for current cabling sizes. A Bonding (Track Insulation) Plan shall always be included in the signal design, even if there is no change to the existing configuration.

Double rail traction return shall be provided wherever practical on main running lines.

5.7 Turnout Size

A maximum turnout radius of 800 metres shall be adopted, so that only one switch machine / spring assist or back drive is required; thus avoiding additional motors being provided for back drives.

Swing nosed crossings should not be used, unless specifically requested and approved by RailCorp for a particular location. A specific design will be required.

5.8 Spares

If the item is unique to that particular installation (i.e. if not a common spare, currently available from RailCorp stores), a spare of each item shall be provided to RailCorp.

5.9 Competency

Only suitably licensed signalling personnel shall be engaged to interferer with operational signalling, which includes the booking out and disconnection of affected signalling apparatus, and any correlation or disconnection of terminated cables and wires. Suitably Licensed signalling personnel shall supervise the removal of disconnected signalling equipment from the track. Suitably Licensed signalling personnel shall control the installation of signalling works and may be assisted by Authorised signalling personnel. Personnel for testing, commissioning, certification and hand-over works shall be in accordance with SPG 0711.1 and the signalling safeworking procedures.

Personnel competent to execute the signalling works must possess appropriate competencies as prescribed on their Certificate of Competency and hold a relevant Permit to Work for the work.

5.10 Stagework

Where a point is installed in track before the signalling is complete, a signalling design is required to ensure suitable bonding is provided for train detection, traction return, and the switches are detected in signals, and the switches are suitably secured in accordance with ESG 100.14 (14.16).

6 Design

Design documentation shall include the Circuit Design, Signalling Plan and the Track Insulation Plan. It may also include an air design, power supply design and any design required for the specific location.

The design documentation must include all relevant circuits whether existing, being rewired or new, even if the existing design does not change, thus permitting the document to be used for testing.

The signalling design should address but not be limited to:

- Point Layout Design based on RailCorp's approved typical point layout drawings. Any changes will require approval.
- Signalling Plans and Circuit Design;
- Track Insulation Plans;
- Material details;
- Mechanical Interlocking Design to be approved by RailCorp;
- Cable Route Design (Refer DSS Services Survey);
- Mechanical / Civil Design for Housings / Locations / Equipment;

- Any changes to signalling infrastructure shall only be undertaken with the approval of RailCorp;
- Temporary Signalling Design to maintain:
  - Adjacent train services; and
  - Traction return bonding;
- Determination of the new gazetted permanent speed through the turnout road, as per RailCorp's operational requirements;

If points relocation is greater than 2 meters (i.e. not like for like) then the following changes / implications need to be examined and perhaps redesigned

- Cabling needs extending, particularly tail cables;
- Track Circuit lengths may end; Track Circuit lengths of less than 20 metres long may require redesign;
- Block Joints may need to be relocated;
  - Track Lengths change;
  - Track timers change;
  - Overlaps may change;
  - Signals may relocate;
  - Braking distance and signal sighting needs assessment;
- Air gaps may be fouled;
- Interlocking changes may be required;
- Panel changes and changes to ATRICS may be necessary;
- Speed changes / longer switches or crossings may be installed, but the following must be considered:
  - Braking distances may be affected;
  - Overlaps may change;
  - Aspect sequence may change;
  - Point repeaters may be required;
  - Approach interlocking may alter;
  - Run off space and signalling controls for catchpoints may be changed;
  - Recabling may be required;'
  - New location boxes may be required.

Where there is an upgrade of control equipment then the following shall be considered:

- Old Relay Interlockings with Shelf Relays or Industrial Contactors:
  - Upgrade to QBCA1 or Q Relays;
  - NLR / RLR to interface to older interlockings;
  - Isolating Relays to be installed in signal huts;
  - Point Transit Timers to be provided (WTJR);
  - Cabling from signal box to location may change;
  - Accommodation in housing (lack of space and shelf to plug-in issues) to be considered;
  - Cables to the points machine – may need recabling from location to points machine.
- Mechanical Signal Box:
  - Upgrade to QBCA1 or Q Relays;
  - NLR / RLR to interface to older interlockings;
  - Isolating relays to be installed in signal huts;
  - Point transit times to be provided (WTJR);

- Cabling from signal box to location may change;
- Accommodation in housing (lack of space and shelf to plug-in issues) to be considered;
- Cables to the points machine – may need recabling from location to points machine;
- Interlocking changes (FPL levers become redundant);
- Lever locks and floor plate contacts to be changed / provided;
- Track locking required for motor points;
- Coloured light signals required for mechanical signals that lead over the points;
- Signal Box Diagram and lever light changes required;
- Removal of channel Iron, wire locks, cranks, footings, A-Frames, etc would be required;
- Power supply upgrades may be required
- Note: It is RailCorp's policy not to alter interlocking in existing mechanical frames.
- Channel Driven End:
- Additional control equipment may be required;
- Power supply upgrade (potentially) may be required;
- New cabling may be required;
- Space in signal hut / housing to be assessed and provided;
- Access for hand operation to be provided.

Where there is a change of motor then the following shall be considered:

- Electric to Electro-Pneumatic (EP):

  - Control circuitry changes;
  - Emergency Switch Machine Lock (ESML) / Emergency Operation Lock (EOL) changes;
  - Space and Access for hand operation to be provided;
  - Rodding changes may be required;
  - Bearer and Plate changes may be required;
  - Backdrives and spring assists may be changed;
  - Cabling to the machine may change;
  - Air mains to be provided;
  - Air control equipment (A Valves) upgrades may be required;
  - Additional cabling for EP Motor may be required;
  - Manifolds to be provided;
  - Compressor capacity to be checked and the required capacity provided;
  - Access to be provided to the master end with EOL push buttons;
  - Control equipment upgrades as follows:

    - Upgrade to QBCA1 or Q Relays;
    - NLR / RLR to interface to older interlockings;
    - Isolating relays to be installed in signal huts;
    - Point transit times to be provided (WTJR);
    - Cabling from signal box to location may change;
    - Accommodation in housing (lack of space and shelf to plug-in issues) to be considered;
    - Cables to the points machine – may need recabling from location to points machine.

  - Non standard ends (E / A / Signal Branch Valve Types) require unique circuitry. (As there are no Standards for the old equipment, a unique design may be required).
  - Interfacing of old plunger lock and equipment circuitry;
  - There is a high probability of additional cabling requirements from the points motor to the interlocking.

Electro-Pneumatic to Electro-Pneumatic (EP to EP):

- Upgrade of operating valves (E to A, etc) may be required;
- Rodding changes may be required;
- Cabling interlocking changes to the points may be required;
- Air line changes may be required;
- Air manifold changes may be required;
- Access to be provided to the master end with EOL push buttons;
- OH&S issues to be considered (particularly in relation to access);
- Bearer and Plates changes may be required for equipment mounting.

Emergency Crossovers

- Functional Specification will be required to determine all aspects of the installation and fully define the scope.

Half Crossovers

- If changing the motor, but not points at one end, the following is needed:
  - Rodding changes;
  - Drilling of switches / stock rails on old end;
  - Use of universal claw lock bracket to provide additional clearance on conventional layouts

CAUTION

Conversion of existing 53kg/m points to claw lock is not permitted. New points must be 60kg/m tangential.

In Bearer Points Motor Installations

- Control circuitry changes;
- Emergency Switch Machine Lock (ESML) / Emergency Operation Lock (EOL) changes;
- Space and assess for hand operation to be provided;
- Rodding changes may be required;
- Bearer and plates changes may be required;
- Backdrives and spring assists may be changed;
- Cabling to the machine may change;
- WSA 84M or EP Motors only to be fitted.

Change of Rail Size / Switch Length (E.G. Conventional Points to Tangential Points)

- Rodding changes;
- Back drive changes;
- Speed to be assessed; and braking distances – turnout repeaters to be addressed;
- May require a motor change.

These design considerations are generally summarised in the following Signal Design Points Replacement Matrix Checklist:

DESIGN IMPACT TO BE ADDRESSED	POINTS RELOCATION IF > 2 METRES	CONTROL EQUIPMENT UPGRADE – OLD RELAY INTERLOCKINGS WITH SHELF RELAYS & INDUSTRAAL CONTACTORS	CONTROL EQUIPMENT UPGRADE – MECHANICAL SIGNAL BOX	CONTROL EQUIPMENT UPGRADE – CHANNEL DRIVEN END	CHANGE OF MOTOR – ELECTRIC TO ELECTRO-PNEUMATIC	CHANGE OF MOTOR ELECTRO-PNEUMATIC TO ELECTRO-PNEUMATIC	EMERGENCY CROSSOVERS	HALF CROSSOVER (IF CHANGING MOTOR ONLY)	IN BEARER POINTS MOTOR INSTALLATIONS	CHANGE OF RAIL SIZE / SWITCH LENGTH (CONVENTIONAL TO TANGENTIAL)
Cabling needs extending / may change, particularly tail cables	√	√	√	√	√				√	
Track Circuit redesign may be required	√									
Block Joints may need to be relocated	√									
Air Gaps may be fouled	√									
Interlocking changes may be required	√					√				
Panel or ATRICS changes may be necessary	√									
Speed Changes (Turnout Repeaters may need to be addressed)	√									√
Upgrade to QBCA1 or Q Relays		√	√		√					
NLR / RLR to interface to older Interlockings		√	√		√					
Isolating relays to be installed in Signal Huts		√	√		√					
Point Transit Times to be provided (WTJR)		√	√		√					
Cabling from Signal Box to		√	√		√					

DESIGN IMPACT TO BE ADDRESSED	POINTS RELOCATION IF > 2 METRES	CONTROL EQUIPMENT UPGRADE – OLD RELAY INTERLOCKINGS WITH SHELF RELAYS & INDUSTRAAL CONTACTORS	CONTROL EQUIPMENT UPGRADE – MECHANICAL SIGNAL BOX	CONTROL EQUIPMENT UPGRADE – CHANNEL DRIVEN END	CHANGE OF MOTOR – ELECTRIC TO ELECTRO-PNEUMATIC	CHANGE OF MOTOR ELECTRO-PNEUMATIC TO ELECTRO-PNEUMATIC	EMERGENCY CROSSOVERS	HALF CROSSOVER (IF CHANGING MOTOR ONLY)	IN BEARER POINTS MOTOR INSTALLATIONS	CHANGE OF RAIL SIZE / SWITCH LENGTH (CONVENTIONAL TO TANGENTIAL)
Location may change										
Accommodation in Signal Hut / Housing to be considered		√	√	√	√					
Interlocking Changes with FPL Levers being redundant			√							
Lever Locks & Floor Plate Contacts to be changed / provided			√							
Track Locking required for Motor Points			√							
Coloured Light Signals required for Mechanical Signals that lead over Points			√							
Signal Box Diagram and Lever Light Changes required			√							
Removal of Channel Iron, Wire Locks, Cranks, Footings, A-Frames, etc required			√							
Power Supply upgrades may be required			√	√						
Additional Control Equipment may be required				√						
New / Additional Cabling			√	√	√				√	

DESIGN IMPACT TO BE ADDRESSED	POINTS RELOCATION IF > 2 METRES	CONTROL EQUIPMENT UPGRADE – OLD RELAY INTERLOCKINGS WITH SHELF RELAYS & INDUSTRAAL CONTACTORS	CONTROL EQUIPMENT UPGRADE – MECHANICAL SIGNAL BOX	CONTROL EQUIPMENT UPGRADE – CHANNEL DRIVEN END	CHANGE OF MOTOR – ELECTRIC TO ELECTRO-PNEUMATIC	CHANGE OF MOTOR ELECTRO-PNEUMATIC TO ELECTRO-PNEUMATIC	EMERGENCY CROSSOVERS	HALF CROSSOVER (IF CHANGING MOTOR ONLY)	IN BEARER POINTS MOTOR INSTALLATIONS	CHANGE OF RAIL SIZE / SWITCH LENGTH (CONVENTIONAL TO TANGENTIAL)
may be required										
Space / Access for Hand Operation to be provided				√	√				√	
Control Circuitry Changes					√				√	
ESML and EOL Changes					√				√	
Rodding Changes may be required					√	√		√	√	√
Bearer and Plate changes may be required					√	√			√	
Backdrives and Spring Assists may be changed					√				√	√
Air Mains to be provided / Air Line Changes required					√	√				
Air Control Equipment (A Valves) upgrades may be required					√					
Air Manifolds to be provided / or changed					√	√				
Compressor Capacity to be checked and the required capacity provided					√					
Access to be provided to Master End with EOL Push Buttons					√	√				
Non Standard Ends (E / A / Signal Branch Valve Types)					√					

DESIGN IMPACT TO BE ADDRESSED	POINTS RELOCATION IF > 2 METRES	CONTROL EQUIPMENT UPGRADE – OLD RELAY INTERLOCKINGS WITH SHELF RELAYS & INDUSTRAAL CONTACTORS	CONTROL EQUIPMENT UPGRADE – MECHANICAL SIGNAL BOX	CONTROL EQUIPMENT UPGRADE – CHANNEL DRIVEN END	CHANGE OF MOTOR – ELECTRIC TO ELECTRO-PNEUMATIC	CHANGE OF MOTOR ELECTRO-PNEUMATIC TO ELECTRO-PNEUMATIC	EMERGENCY CROSSOVERS	HALF CROSSOVER (IF CHANGING MOTOR ONLY)	IN BEARER POINTS MOTOR INSTALLATIONS	CHANGE OF RAIL SIZE / SWITCH LENGTH (CONVENTIONAL TO TANGENTIAL)
require unique circuitry										
Interfacing of Old Plunger Lock and Equipment Circuitry					√					
Upgrade of Operating Valves (E to A, etc) may be required						√				
OH&S issues to be considered (particularly access)						√				
Functional Specification will be required							√			
Drilling of Switches / Stock Rails on Old End								√		
Use of Universal Claw Lock Bracket to provide additional clearance on conventional layouts								√		
Motor Change may be required										√

6.1 Pre-Possession Construction Works

All works shall be in accordance with SPG 0711.6, PWA, approved Inspection and Test Plans (ITP's), Installation Work Package (IWP) and Commissioning Work Package (CWP), RailCorp Signalling Engineering Standards & Procedures, and the Network Rules & Procedures.

Perform signalling installation works in Pre-Possession Closedowns and during other permitted / approved periods of site access, including but not limited to:

- Correlation work
- Cabling works, including new cables if required, wiring works, cabinet installations, relocation of signalling equipment, mechanical installations and pre-testing;
- Mechanical civil works for housings, locations and equipment;
- Temporary signalling construction works to maintain;
  - Adjacent train services; and
  - Traction return bonding;

6.2 Pre-Assembly of Points on site

Pre-assemble point signalling hardware to the points prior to the installation in track. Remove the signalling hardware prior to the points' installation. Re-install and adjust after track resurfacing (to minimise any risk of their damage during point installation, ballasting and resurfacing)

The turnout shall be assembled in accordance with the design. Quality checks on the correctness and in readiness of the assembled turnout for in-track installation must be completed in accordance with the approved Inspection and Test Plan. Pre-assembly of the turnouts and associated signalling equipment shall be completed in adequate time to allow final inspection on design compliance prior to the installation Possession.

The works shall be inspected / tested at hold points defined in their ITP's. Hold points shall apply to but not be limited to pre-assembled turnouts, crossover components, diamonds, catchpoints and related points machines, rodding and associated signalling components.

Complete turnout inspection forms and check lists (using words and numbers and not ticks / crosses used) to record details of the pre-assembled turnout.

6.3 Turnout Setting Out

Ensure that the locations of insulated joints are in accordance with RailCorp approved Track Insulation Plans.

Install low-profile 'e-clips' suitable for concrete bearers (referred to as e-1629 blue clips) at GIJs in accordance with RailCorp Engineering Standards.

6.4 Removal of Track

Where track is removed and signalling infrastructure must be maintained then signalling approval must be obtained from RailCorp, as the design will be impacted.

6.5 Protection of Signalling Infrastructure and the Integrity of Signalling Equipment

Ballasting –Ensure that there is no high ballast, which will interfere with the infrastructure (e.g. trainstops). Ballast shall be clear through switch-blades, around points, rodding, crossing and level crossings and checkrails. Ballast should not interfere with the integrity of signal bonding.

Resurfacing – (Junctions Resurfacing)". The throw off rail of any catchpoint may need removal before tamping to avoid any damage to the infrastructure, then reinstalled following completion of the works.

- Ensure that the new turnout and components are not damaged during the resurfacing works. When resurfacing the turnouts, the switches shall be clipped and locked to provide tamping through turnout road.
- Ensure that any ballast is cleaned out through the switch area, around points rodding and crossing checkrails / flangeways, and nearby infrastructure equipment, to ensure the integrity of the turnout operation.
- On completion of the resurfacing works, ensure if applicable that the track circuit and bonding connections are reconnected, inspected and tested;

CWR Track Adjustment – Welders shall provide their own long temporary bonds to allow welding to progress during signalling commissioning works. A minimum of twelve (12)-off long bond cables shall be held on site.

6.6 Commissioning and Certification of Signalling Infrastructure

Certify the Signalling Infrastructure Works (whether new, altered or affected) in accordance with RailCorp's Signalling Commissioning Standards SPG 711, including completion of all Safety Critical signalling works. The approved Signalling Commissioning Engineer shall book it into use by signing the Infrastructure Booking Authority (IBA) Handover Form, prior to hand-back of the infrastructure. This also includes the interfaces between disciplines.

Document the construction and commissioning work by ITPs consistent with the design, SSMP, IWP and CWP which include:

- 1,500 Volt traction negatives to impedance bonds to be disconnected and verify whether such disconnection shall be via electrical or signalling personnel;
- 1,500 Volt spark gaps to be disconnected and verify whether such disconnection shall be via electrical personnel;
- Trainstops to be disconnected, if required;
- Cables and air lines as applicable to be disconnected, including those laid in new cable routes, as required;
- Track Circuits (and associated equipment) to be disconnected;
- Any other Signalling Equipment, as required to be disconnected (e.g. points, warning lights, signals, etc).

Perform traction return bonding, and CAD welding, as follows:

- If new rail has been installed, the Signalling personnel are to identify the Traction Rail and install new CAD weld studs for connection of Negative Traction Return Leads;
- Where Electrical or Signalling personnel have removed Negative Bond Leads, and the same Electrical or Signalling personnel or personnel with comparable competencies, are to connect leads to studs;
- Lead connections are to be certified by RailCorp to verify they these have been installed on the correct rail / track in accordance with the supplied Track Insulation Plan, all with reference to connection of Negative Traction Return Leads.

- The reconnection of all bonding (including but not limited to that stated above), in accordance with the Network Rules & Procedures and Signalling Safeworking Procedures Manual J and the approved Signalling Design.

Inspect all affected infrastructure for damage and undertake restoration in accordance with but not limited to the Network Rules & Procedures, Signalling Safeworking Procedures Manual J, and test and certify the Signalling Infrastructure.

Testing of affected signalling apparatus shall be performed in accordance with Signalling Safeworking Procedures Manual J before certification.

A Train Shunt Test shall be performed on newly installed rails or where the period of non use exceeds 72 hours or otherwise where doubt exists in the shunting capability of the rail surface. This test shall confirm the integrity of the affected signalling system; and if necessary undertake localised rail grinding of the head of the new rail or the affected rail, to achieve an effective train shunt.

An operational test of affected signalling equipment shall be undertaken from the signal box before booking the equipment back into service.