Division / Business Unit: Safety and Systems
Function: Signalling
Document Type: Procedure

Management of Signalling Failures

ESP-00-04

Applicability

ARTC Network Wide SMS

Publication Requirement

Internal / External

Primary Source

ESM-00-04

Document Status

Version #	Date Reviewed	Prepared by	Reviewed by	Endorsed	Approved
1.0	Apr 25	Engineering Services	Stakeholders	Principal Signalling Engineer	Manager Engineering Services 02/04/2025

Amendment Record

Amendment Version #	Date Reviewed	Clause	Description of Amendment
1.0	Apr 2025		Merged ESM-00-02, ESM-00-03 and SMP 04 into this document. Included reference to relevant ARTC Asset Management Documents. Document renumbered from ESM-00-04 as per EGP-01-02.

Table of Contents

1 Introduction

1.1 Purpose

1.2 The purpose of this document is to provide requirements for the management of signalling system and equipment failures. Scope

Scope of this document covers all signalling equipment and systems, and the document is applicable to the entire ARTC network.

1.3 Document Owner

The Manager Engineering Services is the Document Owner. Queries should be directed to standards@artc.com.au in the first instance.

1.4 Reference Documents

The following documents support this procedure:

- ESM-00-10 – Testing and Certifying Equipment Worked on or Altered During Maintenance
- ESM-00-12 – Disconnection of Signalling Apparatus
- ESP-21-01 – Bridging or False Feeding Signalling Circuits
- ESP-00-03 (SMP 08) – Booking Signalling Equipment Out of Use
- SMP 03 – Accidents or Derailments – Actions to be taken
- AMT-PR-010 – Enterprise Asset Management System
- AMT-WI-024 – Known Condition Management
- AMT-WI-030 – Recording of Rail Events in Ellipse
- AMT-WI-025 – Work Order Management
- Operational Rules – NSW Rules, TA20 and CoP

1.5 Definitions

The following terms and acronyms are used within this document:

Term or acronym	Description
ARTC	Australian Rail Track Corporation Ltd.
CoP	Code Of Practice
EAMS	Enterprise Asset Management System
ESML	Emergency Switch Machine Lock
EOL	Emergency Operation Lock
IBA	Infrastructure Booking Advice
WSF	Wrong Side Failure

2 Signals Fault Management

Signal Engineering and Maintenance team is to ensure safety critical and other faults in the ARTC signalling systems are adequately managed and resolved.

ARTC maintains an Enterprise Asset Management System (EAMS) to manage assets throughout their lifecycle and to ensure that assets are fit for the purpose of allowing the safe and reliable operation of trains over ARTC infrastructure.

Maintainers responsible for signalling maintenance shall clearly understand that the object of good maintenance is to prevent failures by planned maintenance activities and intelligent anticipation rather than waiting until they happen.

In the case of an accident, emergency and failure of signalling, control systems or level crossing apparatus, signal maintainers shall attend with all due urgency in order to deal promptly and safely with the apparatus and rectify any failure. Signalling failure can either be a potential or actual source of train delays. In such situations, signal maintenance staff should assist other ARTC staff where possible, to minimise the train delays. Temporary repair may help in minimising the train delays. The signal maintenance engineer is to review all temporary works and ensure risks continue to be managed until permanent repairs are completed.

2.1 Reporting and Recording of Signalling Failures

Every signalling, or level crossing failure shall be reported, recorded and analysed so that appropriate measures can be taken to reduce such failures and prevent reoccurrence. All failures requiring the attention of a maintainer shall be fully investigated and all details shall be documented in the Enterprise Asset Management System. Refer to the Asset Management Documents listed in Section 1.4.

Signal maintenance staff shall record the failure details in the EAMS which includes but not limited to the detail of repairs, tests performed and root cause of the failure.

For wrong-side failure, a detailed technical report shall be provided by the Investigating signal engineer for review and further action by the Signal Engineering Manager.

For right-side failure, a failure report should be prepared by the signalling staff if required by the signal maintenance engineer or signal engineering manager.

2.2 Duties and responsibilities

ARTC asset management team is responsible for signalling maintenance management, administration and supervision responsibilities.

The Signal Maintenance Engineer should co-ordinate with the Operational Technology team to plan minimising the signalling alarms on the network controller’s screen which are not necessarily required for network controller, for example, alarms still present from the previous signalling decommissioning works, maintenance alarms going to the controller’s screen etc.

The responsibilities and authority for specific positions will be determined as set out in particular position descriptions and duty statements.

3 Signalling Irregularities and Wrong Side Failures

A signalling failure is termed an irregularity when signalling equipment items or circuits do not function correctly in accordance with their design to provide the intended protection.

A signalling irregularity is termed wrong side failure under the following conditions such as but not limited to:

- A signal shows a less restrictive indication for a train than conditions allow
- A set of points are released under rail traffic conditions when they should be locked
- Where the automatic level crossing protection fails to operate for a train.
- Detectors – If signals can be cleared incorrectly i.e. with facing points not closed or not locked
- Track Circuits – If a track circuit fails to detect the presence of a train
- Mechanical or Electrical Interlocking – If a release can be incorrectly obtained from the locked position
- Electric Locks – If a lock is incorrectly free.

All irregularities and wrong side failures detected shall be reported to the Network Controller at the first instance detailing the incident, recorded and managed as per the asset management documents listed in Section 1.4.

Following the establishment of the necessary safety procedures on site, the Maintainer shall obtain as much relevant information as they immediately can and relay the information to the Signal Maintenance Engineer and Area Manager immediately.

All irregularities, whether they result in an unsafe system failure or not, shall be promptly investigated by an investigating signal engineer.

A separate file uniquely identified for each signal irregularity or wrong side failure shall be kept. These files shall not be closed until all investigations and enquiries have been completed and all recommendations, corrective and preventive actions have been satisfactorily implemented.

Every signal irregularity or alleged signal irregularity shall be reported, recorded and analysed so that appropriate measures can be taken to reduce such failures to a minimum.

3.1.1 Signalling Irregularity Investigation and Train Operation

The procedure for dealing with signalling irregularities by the Investigating signalling staff is generally as follows:

Establish that the reported situation constitutes an irregularity.

Book out signalling equipment concerned, that is alleged to have not operated in accordance with their design to provide the intended protection.

Provide site protection by booking out and disconnecting any signal route to prevent trains approaching the signalling equipment concerned given the reported circumstances.

Care should be taken when opening or working on equipment to prevent destruction of evidence and prevent determination of the true cause of the irregularity.

The failure conditions shall be examined and noted by the investigating signalling staff in an attempt to determine the cause of the irregularity without disturbing the fault or associated evidence.

If the cause of the irregularity is positively determined by the Investigating signalling staff but cannot be rectified without delay, and if under the prescribed procedures train operations using the signal can be safely allowed by disconnecting and securing the defective equipment in a safe state, then the signals providing protection may be restored to use once the defective equipment has been disconnected and secured .

While testing is being carried out, book out and disconnect any signalling equipment which is subject to interference by the testing work and could endanger the passage of trains.

Note: Photographs may be useful, and all observations, measurements and witness reports should be recorded in the report.

3.1.2 Securing the Evidence

It is necessary that the incident circumstances and the signalling concerned to be kept as undisturbed as possible until relevant symptoms are noted, and inspections and tests are conducted by authorised persons.

Where tests necessarily require the equipment to be interfered with or disturbed then the Investigating signalling staff shall arrange to carry out these tests after carrying out other non-disturbing inspections and tests that may determine the cause or reduce the possibilities by elimination.

3.1.3 Signalling Irregularity Investigation to Determine Cause

It is the duty of the Investigating signalling staff to determine whether there has been a signalling irregularity and if so, determine its technical cause through inspection and testing of the signalling apparatus.

It is difficult to prescribe particular inspections and tests for irregularity investigations as circumstances can vary greatly and reports may range from anonymous, vague recollections to specific allegations to cases where the irregularity occurrence is obvious.

Whatever the case the Investigating signalling staff is accountable for certifying that the signalling involved is safe by signing the equipment back into use.

The Investigating signalling staff shall therefore be satisfied that the correct cause has been conclusively identified and rectified or that the integrity of the signalling has been verified.

There is a further requirement that the Investigating signalling staff and management determine and correct any deficiency in the signalling or in the control systems including deficiencies in staff competency, supervision and procedures.

3.1.4 Restoration of Equipment

Identify and rectify the cause. Record test results and findings and attach to detailed report.

Test and certify the signalling system as safe and operational.

Book the signalling system back into use.

If the signalling system is likely to be out of use for some time and trains services are going to be seriously affected, the Investigating signalling staff shall consult with the Network Controller to determine if other permissible means of protection that will ensure a safe situation but minimise the disruption to train services can be employed.

3.1.5 History of the Apparatus involved

An examination of the failure, maintenance and operating history of the apparatus concerned may provide useful information.

It may be that a defect has been present for some time and has only come to attention under the circumstances of the irregularity incident.

For an irregularity to occur after a previous history of correct operation something shall have changed such as but not limited to:

- A set of operating conditions occurs for which deficient signalling design or incorrect installation does not provide protection.
- Degradation or catastrophic change occurs in the physical properties of materials or equipment on which fail-safe operation of vital circuits and equipment are dependent.
- A false feed occurs from one circuit to another.
- A current leakage path falsely qualifies part of the correct selection in a circuit.
- Detection or indicating equipment becomes out of adjustment.
- Foreign matter interferes with correct train detection.
- Foreign matter or lack of lubrication obstructs gravity return or spring return devices.
- Worn or defective bearings or linkages obstruct gravity return or spring return devices or cause lost motion in drive mechanisms or in detection mechanisms.
- A complete interruption of power supply to protection systems occurs.
- Time limit release devices shorten from time interval stipulated.
- Interference from personnel alters adjustment, correspondence.
- Damage occurs affecting the integrity of the equipment in the operating environment.

3.1.6 Investigation Strategy

The Investigating signalling staff will need to gather the evidence and study the circumstances and details of the alleged irregular incident, accident or derailment.

The Investigating signalling staff will need to devise a strategy and plan for investigating the cause. This could change as evidence unfolds or as suspect items are eliminated.

The Investigating signalling staff may need to:

Analyse: whether the evidence allows the cause to be localised to the trackside apparatus itself or the controls to or indications from the trackside apparatus.

Identify: all related circuits and equipment items that control and operate the trackside apparatus and provide indications of its operations.

Inspect and Test: those circuits and equipment items to check that they are installed and operate correctly to the specifications design drawings and to the interlocking and control tables.

Deduce: what omission, interference or other deviation factor could have caused irregular operation of the apparatus or the related circuits and equipment items.

Ascertain: whether those factors are or could have been present at the time of the incident using appropriate inspection and tests together with analysis of witness reports, event recorders and other clues.

Attempt: to reproduce the alleged irregularity.

The Investigating signalling staff should understand the respective signalling system, its components and the operating environment.

The Investigating signalling staff shall seek expert advice and assistance if not satisfied that the inspections and tests have successfully determined the true cause or verified the integrity of the signalling.

3.1.6.1 Inspections and Tests

The investigation may involve the following inspections and tests:

- General apparatus inspection
- Circuit testing
- Apparatus function testing
- System functional testing

Look first and only when satisfied proceed to function test, insulation test, circuit test etc.

The investigation will seek to verify conformance with the designs, compliance with installation standards and correct adjustment, correspondence, interlocking and control of the trackside equipment concerned.

The inspections would start with a close, critical examination of the operating equipment involved particularly of the mechanical operation of mechanisms such as relays, looking for signs of damage, interference or irregular behaviour.

Electrical wiring and terminations and mechanical linkages and connections would be similarly inspected.

Function tests to the control tables of the interlocking and controls between the items of trackside apparatus involved, correspondence and adjustment tests of those items and then delve more deeply into the individual elements of the controls and indications.

When a defect is found that conclusively accounts for the problem and the Investigating signalling staff considers that multiple causes would not exist then further testing need not be performed.

Depending on the incident the inspection and tests could typically involve the following:

- Inspection of the aspects of signals
- Mechanical interlocking inspections and tests
- Electro-mechanical interlocking inspection test
- Electrical interlocking and control tests

- Train detection tests
- Electrical insulation / isolation inspections and tests
- Circuit test to wiring diagrams
- Security inspections
- Signal inspections

4 Right-Side Failures

Right-side failure is a signalling failure which results in a safe condition for train operations and may cause train delays.

Some examples as below:

1. Track circuits occupied when there is no train
2. Signal displaying Stop aspect while a route is set, and signal is expected to display proceed aspect
3. Level crossing ringing when there is no train on the approach

4.1.1 Failure of Signal Aspect

Defective signals that have failed 'right side' shall be made to remain at stop until the apparatus has been restored to correct working order.

In the case of a signal showing a less restrictive signal indication than conditions should allow, the signal next in rear shall be disconnected and protected by appropriate safeworking procedures until the 'wrong side' failure is investigated by a Signal Engineer.

4.1.2 Failure of Electric Lever Locks on Signals

When the normal electric lever lock fails on a signal lever, the lever shall be kept in the normal position until the failure has been rectified.

When the normal electric lever lock fails on a distant signal lever, the signalling maintainer shall check that the distant signal displays 'caution' and the signal shall be kept at caution until the failure is rectified.

When the normal electric lever lock fails on a stop signal, the signal lever shall be maintained at stop and rail traffic shall be conducted in accordance with the applicable Network Rules and Procedures.

4.1.3 Failure of Power Operated Points

When power operated points have failed, no attempt shall be made to unlock or move the points other than by normal operation from the lever (or operating console/panel/keyboard) unless:

- the points are disconnected and booked out of use

  or

- emergency facilities, interlocked with the signalling, are specifically provided to enable failed power worked points to be operated by hand (e.g. Emergency Switch Machine Lock (ESML) and Annett Key with attached crank handle, Emergency Operation Lock (EOL), plug connector and key).

In all cases, the signaller shall be requested to place affected controlled signals at stop before the emergency facilities are taken and closely approaching trains shall come to a stand before the points are manually operated.

In all cases of hand operation of power worked points during failure or emergency, the controlling lever in the signal box should be placed to correspond with the position to which the points are operated by hand.

Power operated points shall not be moved out of correspondence with the interlocking unless they are disconnected electrically and the signals reading over the affected points are disconnected and securely maintained at stop. Distant signals, or the equivalent of the distant signals, shall also be arranged to be maintained at caution.

Before rail traffic moves are permitted overpower operated facing points that have failed, the requirements of applicable Network Rules and Procedures shall be observed.

After the emergency operating facilities have been returned to their cabinet:

- the facing points do not have to be clipped and locked as long as the detector light on the signallers indicator diagram shows that the points have been correctly set

  or

- the facing points shall be secured in the correct position by point clip and SL lock when the detector light on the signallers indicator diagram shows that the points have not been correctly set.

In the case of power worked trailing points, the authorised employee shall operate (wind) the trailing end of the points first and the hand signallers shall ensure that all points on the intended route are in the correct position for the train to proceed.

Under these conditions, signalling maintainers shall request that trailing points be clipped for hand signalled moves to avoid damage to point machines due to run throughs.

4.1.4 Failure of Isolating Relays on Electrically Operated Points

In the event of a failure the isolating relay on electrically operated points, the signalling maintainer may release isolating relay, at the points, on each separate occasion as required, to enable the points to be operated from the signal box.

If the isolating relay is not effectively locking and preventing the irregular movement of the points, then the points shall be regarded as being defective and no rail traffic movements shall be made over them until they have been secured by clip and lock.

4.1.5 Failure of Point Detection Due to Damage

When a failure of electrical point detection is caused by damage or other reason that requires the replacement of a significant part of the points detection mechanism and, if it is necessary to avoid significant disruption to rail traffic until it can be rectified, it will be permissible on authority being given to take emergency action to bridge the affected detection contacts to allow the normal clearance of signals leading over the diamond crossings or over the trailing end(s) of the defective points in question.

The emergency action shall be as prescribed in ESM-00-12 Disconnection of Signalling Apparatus and ESP-21-01 Bridging or False Feeding Signalling Circuits.

4.1.6 Failure of Level Crossing Protection Interlocked Gates or Boom Barriers

In the event of a failure of interlocked boom barriers, or when carrying out repairs to this equipment which may interfere with the interlocking, rail traffic shall be conducted over the level crossing in accordance with the applicable Network Rules and Procedures. The fixed signals protecting the interlocked level crossing shall be disconnected and the associated distant signals or equivalent shall be arranged to be securely maintained at caution, and rail traffic conducted past the protecting signals in accordance with the applicable Network Rules and Procedures.

Hand signallers shall be provided in accordance with the applicable Network Rules and Procedures in event of failure or when work is being carried out which affects the normal operation of the level crossing.

4.1.7 Failure of Track Circuits

4.1.7.1 Track Failures General

In the event of a track circuit failure, no attempt shall be made to clear any of the signals controlled by the track circuit by manipulating the track circuit relay, bridging across the track circuit relay contact terminals and so on.

The signals controlled by the track circuit shall remain at stop until the track circuit is again in working order, and rail traffic shall be conducted past them in accordance with the applicable Network Rules and Procedures for passing the signal at stop.

Track and indication locking controlled by a failed track circuit may be released by the signalling maintainer only as prescribed in SMP 06 Release of Track Locking or Indication Locking.

4.1.7.2 Tracks Failing to Shunt

When rails in sections of a track circuit are in such a condition that vehicles cannot be relied upon to shunt the track relay, the signalling maintainer shall disconnect and book out of order all signals, points or level crossing protection affected by the track concerned until satisfied that a vehicle will properly shunt the track relay.

When the defective track controls the lock on any point lever, the points concerned shall be clipped and locked until such time as an effective shunt has been obtained.

The signalling maintainer, when booking the equipment concerned out of order, shall complete the ANRF 003 Infrastructure Booking Advice form, confirm that an entry is made in the Train Register Book and signed and exhibit a list of the defective track or tracks in the signal box until they are again in order. In all cases, where doubt regarding the proper shunting of a track circuit exists, signalling maintainers shall immediately inform their maintenance supervisor, advising the circumstances and action taken.

4.1.7.3 Broken Rails

Signalling maintainers who become aware of a broken rail that is a danger to rail traffic are to arrange for the immediate protecting signal(s) to be placed at stop and disconnected, for a hand signaller to be provided and for the attendance of the civil representative.

Where the broken rail and track circuit failure is causing significant delays due to points being inoperable, or more than one signal or home/starting or starting signals are being held at stop, the signalling maintainer, after receiving assurance from the civil engineering employee and

confirmation from the signaller that temporary repairs have been made, and the line is fit for rail traffic, may place a temporary bond around the break and restore the disconnected signal(s).

4.1.8 Relay Interlockings – Relay Failure

In standard relay interlockings, if a failure occurs to the interlocking circuits resulting in a failure of a reverse relay in the case of a signal lever, or a reverse or normal relay in the case of a point lever, or release switch lever, rail traffic shall be conducted in accordance with the Applicable Network Rules and Procedures until the defect is rectified.

In route control interlockings, should a failure occur of a route reverse lock relay (RLR or RUR) or release switch or point (NLR or RLR), rail traffic shall be conducted in accordance with the Applicable Network Rules and Procedures until the defect is rectified.

On no account shall any of these relays be lifted or unplugged and replaced by a relay in the up position.

Where magnetically latched relays are replaced, the replacement relay shall be magnetically delatched prior to being placed in the circuit.

4.1.9 Failure of Section Control Relays in Single Line Track Control Sections

In the event of a failure of the section control relays in single line track controlled areas and with pilot working in use, the signalling maintainer may temporarily bridge out (in accordance with ESP-21-01 Bridging or False Feeding Signalling Circuits) the half pilot staff contacts at each or either end of the section for testing purposes, provided that the starting signals at both ends of the single line section are otherwise disconnected and booked out of use.

5 Signal Failures Not Replicated

This includes failures that self-rectify or rectify after the passage of a train or other unknown circumstances.

5.1.1 Investigation of Signal Failure Not Replicated

This includes no cause found, intermittent and cleared on arrival failures.

In the case of a failure for which the cause is not replicated the failure shall be fully investigated such as but not limited to:

- All voltage and current readings associated with the equipment
- Earth leakage tests
- Cable condition assessment
- Visual inspection of all equipment
- Terminal condition and tightness
- Track circuit integrity (e.g. walk the track)
- Point layout inspection - Lock and detection, fasteners, rail condition (stock rail and blade), geometry.
- Ask questions and seek answers from Network Controllers, Train Crews etc.

Note: take and review all relevant logs for the equipment involved.

Steps shall be taken to avoid the recurrence.

The self-rectification of a failure shall not, in itself, be considered as the final action to be taken.

Follow up investigation and review should be undertaken to minimise the likelihood of the failure reoccurring.

If the failure should happen again and cannot be replicated, then the maintainer shall escalate to the Signal Engineering team/Area Manager for further investigation.

5.1.2 Signalling Forms

5.1.2.1 ESP0004F-01 No Cause Found Failure Report

The ESP0004F-01SMP04F-01 No Cause Found Failure Report is available on the ARTC Engineering Extranet.

6 Failures caused by Other Disciplines

Where signalling equipment has been damaged by derailment or other event, it is not to be assumed that the equipment did not contribute to the cause. Whatever investigations that can be undertaken shall be conducted.

If a defect or a failure in signal apparatus is found and the cause of which is due to another discipline, then the Maintainer shall bring the defect or failure to the attention of the Signal Engineering team/Area Manager. The maintainer shall update the work order describing the nature of the defect or failure. Any evidence to support the defect or failure should also be updated in the work order e.g. photographs.

The defect or failure shall be entered into the appropriate defect module of the maintenance management system.

The Signal Engineering Team/Area Manager shall notify to the appropriate representative of the other discipline with the priority for attention. as per the table below.

Signal Condition	Related Cause	Impact	Corrective Action	
Point failure	Poor turnout condition	Derailment Point failure Train delays	Maintain turnout to standard	
Track circuit failure	Contaminated rail	Track circuit fails to detect train. Level crossing fails to operate. Train delays	Maintain track, ballast, rail and drainage to standard.	
Track circuit failure	Poor ballast condition Defective insulated joints	Train delays	Maintain track, ballast, rail and drainage to standard.	
Signal Sighting	Obstruction by vegetation or structure	SPAD Increased running time	Remove vegetation or obstruction	