Road/rail vehicle safety

Follow-up workshops

May/June 2013

Brisbane-Sydney-Adelaide

Adrian Rowland

WELCOME - LESSONS FROM THE PREVIOUS WORKSHOP

Previous workshop

- **October 2012 – Sydney**
- **48 participants from a variety of organisations**
- **Briefings providing a variety of perspectives**
  - **Understanding the RRV landscape**
    Kirsty Baxter, Transport Safety Victoria
  - **Management of RRVs – experiences, strengths and weaknesses**
    Lindsay Holt and Andrew Shore, Laing O'Rourke
  - **Management of RRVs – experiences, strengths and weaknesses**
    Alan Ross and Mike Rogers, John Holland Rail
  - **Management of RRVs – experiences, strengths and weaknesses**
    V/Line Hi-Rail Project, Allen Fleckner

- **Preliminary Hazard Analysis using structured what if technique (SWIFT)**
- **Forward actions identified – Strategic/Organisational/Team & individual.**

ITSR Road/Rail Vehicle Workshop

V/Line Hi-Rail Project

Allen Fleckner

October 2012

Rail guidance fitted to light vehicles (“track inspector vehicles”)

The Fleet includes 29 light road rail vehicles used for track inspection.

The rail gear requires regular inspection and adjustment (4 month cycle)

Rail guidance fitted to heavy vehicles (“gang trucks”)

Hi rail mobile gang truck

The RM Track maintenance group operates 18 ‘mobile gangs’ through out the state each equipped with a set of engine powered tools

Night shift is becoming more common requiring better lighting and accessories.

Rail guidance fitted to wheeled excavator

Rail guidance fitted to tracked excavator

A Komatsu 4 tonne excavator fitted with driven rail wheels and a Harsco Scarifier Head.

Concept and design by V/Line Plant in co-operation with Harrybilt

Rail guidance fitted to tracked excavator

A Komatsu 4 tonne excavator fitted with driven rail wheels and a Harsco Tie Grip.

Concept and design by V/Line Plant in co-operation with Harrybilt

Rail guidance fitted to loader back hoe

Vehicle types – Type 9A

- **Type 9A: braking and traction forces transmitted directly to the rail wheels (i.e. the rail wheels are self-powered)**

Figure 1: Example Type 9A RRV with self-powered rail wheels

Vehicle types – Type 9B

- **Type 9B: traction forces indirectly transmitted from the road wheels to the rail wheels and the braking force either indirectly from the road wheels to the rail wheels or direct on the rail wheels, with the load entirely on the rail wheels. These are often known as 'high ride' RRVs.**

Figure 2: Example Type 9B high ride RRV with traction and braking through the road wheels to the rail wheels

Type 9B variation

Figure 4: Type 9B high ride RRV with extensions fitted to the rail wheels (spigots)

Vehicle types – Type 9C

- **Type 9C: braking and traction forces transmitted to the road wheels with the load shared between the road and the rail wheels. These are often known as ‘low ride’ RRVs**.

Figure 3: Example Type 9C low ride RRV with traction and braking through the road wheels

TRANSPORT SAFETY VICTORIA

Risks associated with Hi-Rail vehicles on the rail network

Kirsty Baxter
Manager, Compliance Strategy & Planning

State Government Victoria

Contributing factors framework analysis

All three types have similar problems of runaway risks

- Forgetting handbrake
- Judgment errors
- Poor maintenance

- Type 9B has significant other risks

- Although all three Hi-rail configurations are at risk of runaways, examination of incident data and a detailed risk assessment from UK's Network Rail, determined that type 9B (high-ride) Hi-Rail vehicles posed the highest risk in terms of runaways.

- All three configurations share common runaway risks such forgetting the handbrake, errors of judgment and poor maintenance. However, type 9B Hi-rails have additional risks not shared by the other two configurations.

Analysis of the problem

- On review of various investigation reports, the biggest proportion of previous runaways has arisen during the on- or off-tracking process where the operator placed the Hi-rail, with no brakes fitted to the rail wheels, into a free wheel, unbraked, condition.

- An engineering means to prevent this occurring is progressively being fitted on some Hi-rails both in the UK and Australia. In the meantime, the prevention of a freewheel condition occurring depends on the operator correctly following the on/off-tracking

- Other runaways have occurred during braking where the rails were wet and/or contaminated and gradient has also been a factor in other incidents.

CFF of RAIB report – **Runaway type**

- Twelve of the 18 runaways resulted from uncontrolled movement occurring from rest, usually during the on- or off-tracking process.

- The remaining six incidents involved the vehicle not being able to stop in time, often due the conditions of the track and site (e.g. gradient and rail contamination), travelling at excessive speed, as well as a combination of both.

CFF of RAIB report: **Individual and team actions**

- The vast majority of the incidents (16) involved some kind of human error while operating the road-rail vehicle, such as the operator:
  - putting the vehicle in an unbraked condition; or
  - adopting an inappropriate technique when operating the vehicle.

- Some errors (2) occurred during preparation, such as:
  - the conditions of the track/site were not taking into account into the risk assessment; and
  - poor choice of on-off tracking location.

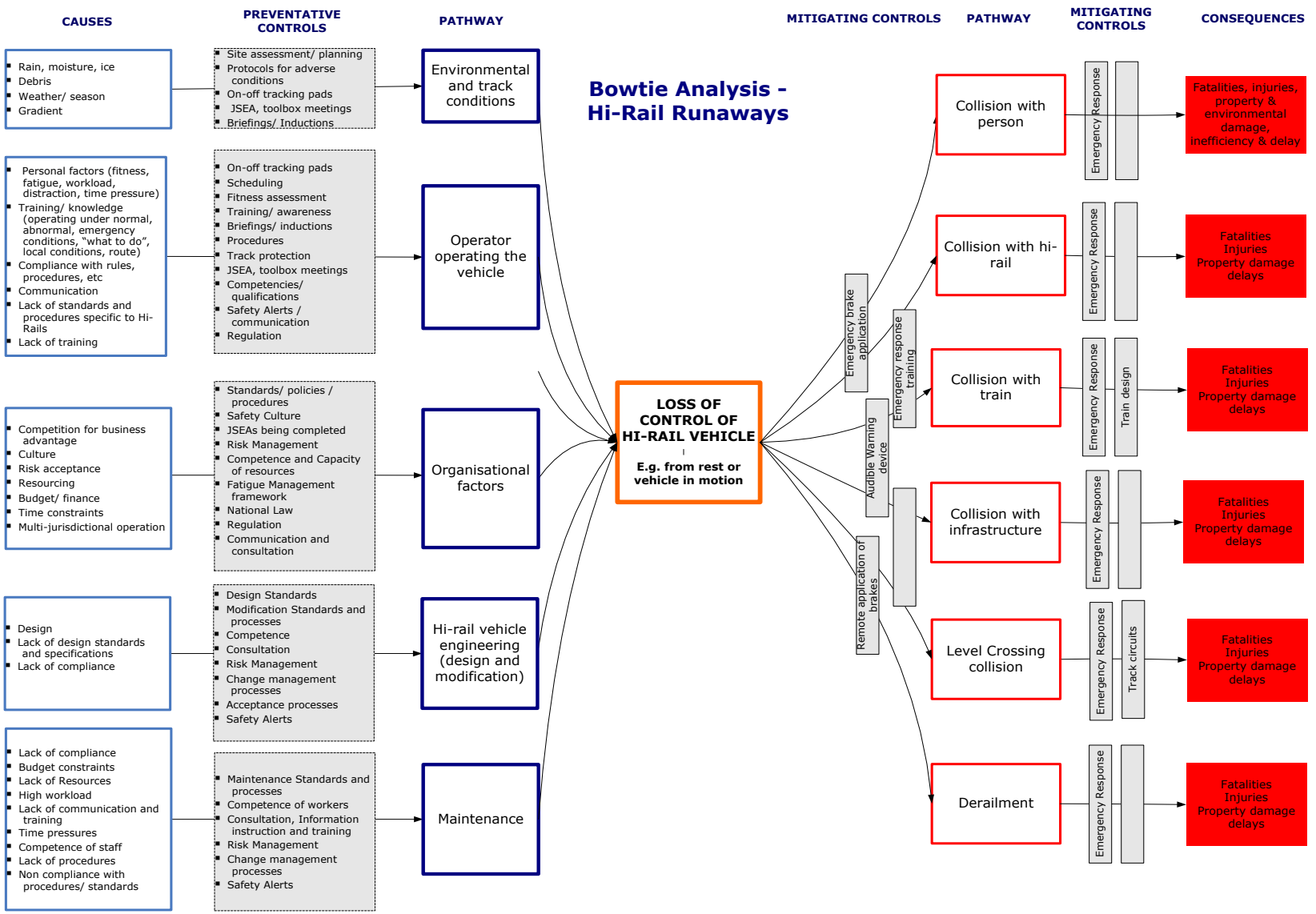
- A few (4) errors also occurred due to a lack of communication between the operator and other track maintenance personnel (i.e. not communicating safety-critical information). There was one potential violation identified where the operator was using the vehicle in a manner contrary to procedures.

CFF of RAIB report: **Technical failures**

- Out of the 18 incidents, only three incidents were found to result from technical failure. These were due to:
  - inadequate maintenance of the vehicle (i.e. tyre pressure not maintained);
  - the design of the park brake (which was unable to be applied due to uncoupling of the hydraulic brake and oil being trapped in the system); and
  - sub-optimal load sharing between the road wheels and the rail wheels of the vehicle.

- Lack of functionality of the road-rail vehicle and equipment was found to contribute to two incidents.

Bow-tie analysis



Hi-Rail – a John Holland Perspective

Road/rail vehicle workshop – 30 October 2012

Michael Rogers

Fatality Perth City Link – 30/12/2011

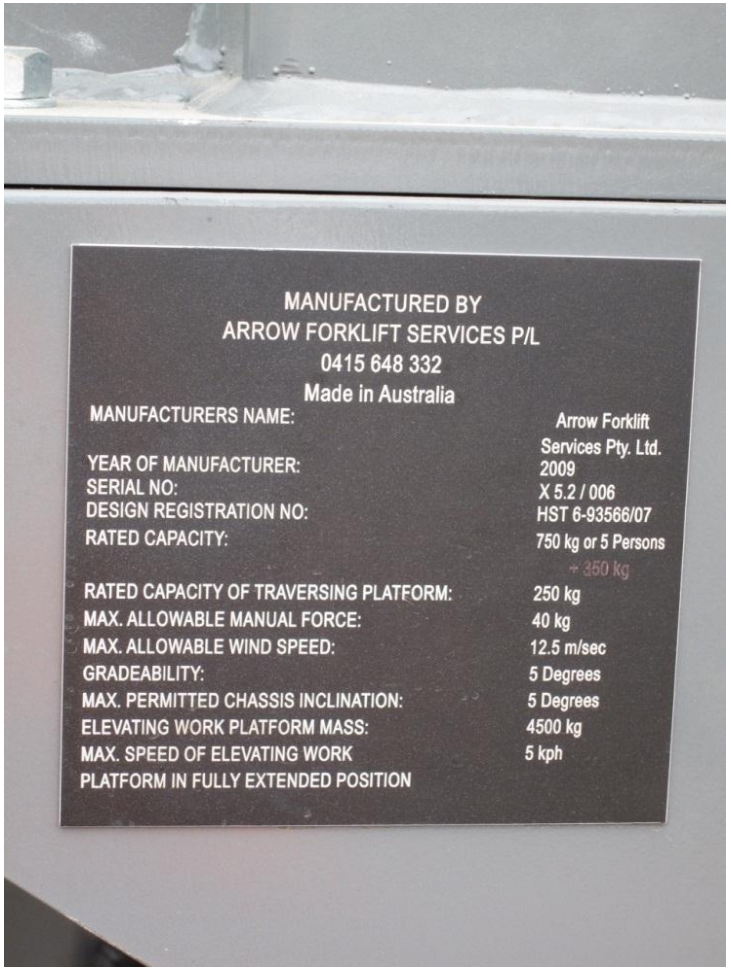
The vehicle involved in the runaway

What are the expectations?

What would eliminating or reducing risks SFAIRP look like?

RRV types have proliferated

What Standards apply?



Where do the figures come from?

Arrow (Rail and Plant Equipment) is a rail industry approved RRV certifier

Other incidents

This type of vehicle has been involved in 2 ‘uncontrolled’ movements, one due to a mechanical fault and the other due to poor traction between road wheels and the ‘spiggots’

Other incidents

The same type of vehicle was involved in a ‘tipping’ incident due to instability


KOMATSU

Incidents

So what are the solutions?

LAING O'ROURKE

LAING O'ROURKE PRESENTATION

ROAD RAIL VEHICLES FROM THEN TILL NOW

SYDNEY 30 & 31 OCTOBER 2012

HOWEVER DURING THE PERIOD ALERTS WERE ISSUED AND DOCUMENTS DEVELOPED

Government of South Australia
Department for Transport, Energy and Infrastructure

RAIL SAFETY ALERT

RSA. No. 2005-05
Page 1 of 1

SUBJECT: SAFETY ALERT TO ALL OPERATORS OF ROAD / RAIL VEHICLES

The following information is provided in the interest of improving rail industry safety performance, and is based on best available information.

BACKGROUND

On 20 October 2005, a Toyota Land Cruiser road/rail vehicle's rear track guidance system self-operated and lifted the rear rail wheels off the track and into the road travel position.

There were no persons in the vehicle at the time and the vehicle was stationary with the engine turned off.

While no injuries or damage occurred the incident had the potential to cause a serious accident.

INVESTIGATION

While the formal investigation process into all aspects of the incident is yet to be fully completed, a significant finding to date is that a primary cause of the incident has been attributed to the inappropriate mounting of a relay enclosure. In this instance the relay enclosure was mounted outside of the vehicle cabin on the left hand (passenger side) chassis rail, midway along the vehicle.

The relay enclosure, protection rated to IP56, has failed in service, possibly from rocks or other material striking the enclosure during operation of the vehicle. This allowed ingress of moisture and dust within the enclosure. Those contaminants appear to have shorted one electrical relay, allowing the supply of electrical current to the rear track guidance mechanism motor. This enabled the guidance mechanism to lift off the rail.

There is sufficient concern regarding safety issues to warrant notification to all operators of such equipment.

In this instance the hi-rail equipment was manufactured by Aries Equipment and Engineering and fitted by a third party provider. Similarly designed and installed equipment may also be subject to similar defects.

SUGGESTED ACTIONS

Operators are requested to inspect all road/rail vehicles and ensure the manufacturer's fitment instructions have been followed.

In particular Aries fitted vehicles should be inspected to ensure the wiring system installation complies with manufacturers requirements, and ensure all relay enclosures are mounted in protected positions within the cabin of the vehicle.

All relay enclosures should be inspected to ensure there are no fractures or cracks in the enclosure and removal of any enclosure covers is recommended to ensure no contaminants have entered the enclosure.

For operators of Aries equipment further information may be obtained by contacting them by telephone on (08) 9248 8611 or fax (08) 9248 8999.

This notice is effective from: 18 / November / 2005

Approved:

Derek Heneker
Acting Manager, Rail Safety

Date: 18/11/2005

RELAY ENCLOSURE ISSUE.DOC REVISION: SAFETY ALERT 2005-05 RAIL ELECTRIC FAILURE.DOC SAFETY ALERT 2005-01 TITLE Footer Page x of x PAGE 1 OF 1

CMC
CODE MANAGEMENT COMPANY

AUSTRALIAN CODE OF PRACTICE

Roll 41-1
(Ver 1.0)

Guideline for the Safe Operation of Road-Rail Vehicles

Daily Road-Rail vehicle checks by End User

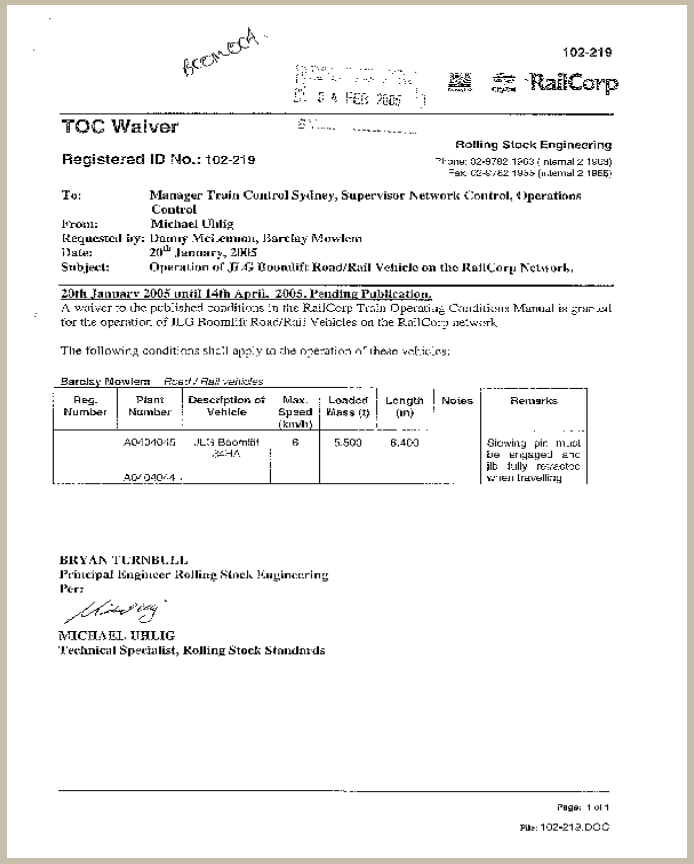
Location		Team	
Date		Vehicle ID No	
		End user (please print)	
Description		Signed:	Week Ending:
Kilometers Last serviced	Start	End Next Service due	TOTAL

Item Ref#	Vehicle Check	M	T	W	T	F	S	S
29	Engine oil check for correct levels							
30	Radiator coolant check for correct levels							
31, 32, 13	Fluids and fuel check for correct levels							
58	Tyre pressures correct							
	Initial							

Item Ref#	Daily Check Road-Rail (√ if OK X if requires attention)	M	T	W	T	F	S	S
57	Tyres, check for damage, tread and wear pattern							
59,55	Tyres, rims wheels check for security, cracks, signs of fatigue							
56	Wheel studs and nuts, check for security or damage							
52,47	Rail wheel check for profile and condition, including sandwich rubber for separation							
51	Rail wheel bearings check for play or noise							
46	Rail wheel studs and nuts check for security or damage							
73,74,75	Mechanical safety locks, rail kits locks, front axle lockout (where fitted) check for correct function damage and wear							
76	Anti derail frame, check for condition							
78	Over centre condition check it is maintained							
83	Rail guidance frame assemblies check for wear, cracks, structural damage and lubrication							
44	Rail sweeps (where fitted,) check are in place and correctly adjusted							
34	Hydraulics, check for correct function or damage							
36	Emergency hand pump, check for presence							
17	Electrical controls, check for correct function, (both) batteries OK.							
18, 20	Head, tail, flashing, reversing, spot, hazard lights for correct function and damage							
21	Warning devices, horns and sirens check for correct function							

LAING O'ROURKE

THE REGISTRATION PROCES CONTINUES FOR ALL TRACK MACHINES BUT CHANGESTO RECERTIFICATION PROCESS MAY APPLY



102-219

RailCorp

TOC Waiver

Rolling Stock Engineering

Registered ID No.: 102-219

Phone: 02-8782 1903 (internal 2 1903)
Fax: 02-8782 1955 (internal 2 1955)

To: Manager Train Control Sydney, Supervisor Network Control, Operations Control
From: Michael Uhlig
Requested by: Danny McLennon, Barclay Mowlem
Date: 20th January, 2005
Subject: Operation of JLG Boomlift Road/Rail Vehicle on the RailCorp Network.

20th January 2005 until 14th April, 2005. Pending Publication.
A waiver to the published conditions in the RailCorp Train Operating Conditions Manual is granted for the operation of JLG Boomlift Road/Rail Vehicles on the RailCorp network.

The following conditions shall apply to the operation of these vehicles:

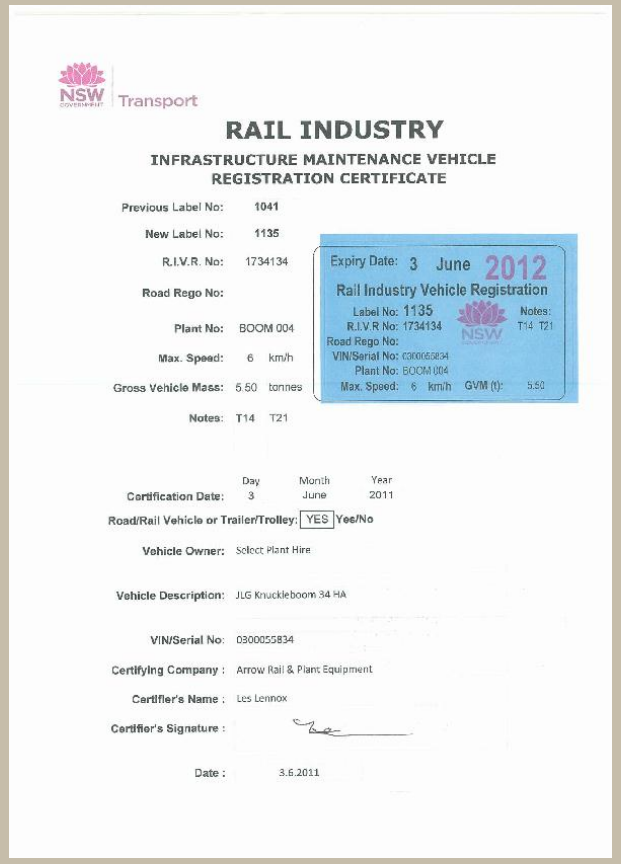
Barclay Mowlem *Road / Rail vehicles*

Reg. Number	Plant Number	Description of Vehicle	Max. Speed (km/h)	Loaded Mass (t)	Length (m)	Notes	Remarks
	A0404045	JLG Boomlift 34HA	6	5.500	6.400		Slewing pin must be engaged and jib fully retracted when travelling
	A0404044						

BRYAN TURNBULL
Principal Engineer Rolling Stock Engineering
Per:

MICHAEL UHLIG
Technical Specialist, Rolling Stock Standards

Page: 1 of 1
File: 102-219.DOC



NSW Transport

RAIL INDUSTRY

INFRASTRUCTURE MAINTENANCE VEHICLE REGISTRATION CERTIFICATE

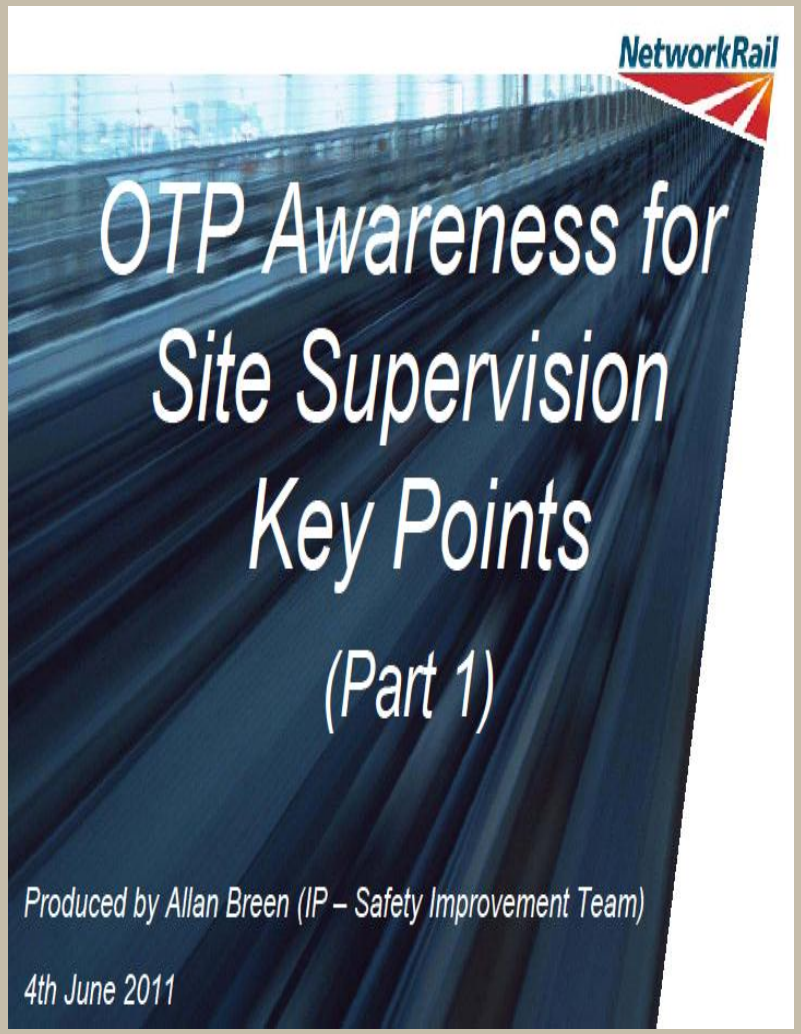
Previous Label No: 1041
New Label No: 1135
R.I.V.R. No: 1734134
Road Rego No:
Plant No: BOOM 004
Max. Speed: 6 km/h
Gross Vehicle Mass: 5.50 tonnes
Notes: T14 T21

Expiry Date: 3 June 2012
Rail Industry Vehicle Registration
Label No: 1135 Notes: T14 T21
R.I.V.R No: 1734134
Road Rego No:
VIN/Serial No: 0300055834
Plant No: BOOM 004
Max. Speed: 6 km/h GVM (t): 5.50

Certification Date: Day 3 Month June Year 2011
Road/Rail Vehicle or Trailer/Trolley: YES Yee/No
Vehicle Owner: Select Plant Hire
Vehicle Description: JLG Knuckleboom 34 HA
VIN/Serial No: 0300055834
Certifying Company : Arrow Rail & Plant Equipment
Certifier's Name : Les Lennox
Certifier's Signature :
Date : 3.6.2011

LAING O'ROURKE

TRAINING WAS PART OF A PROGRAM FOR NETWORK RAIL MORE ALIGNED TO OPERATIONS



NETWORK RAIL WERE ALSO ANALYSING SAFETY IMPROVEMENTS INCLUDING BRAKES

LAING O'ROURKE MEANTIME WERE ANALYSING THE ROLLING STOCK STANDARDS FOR TRACK MACHINES

AS7505.4 Signalling Detection Interface

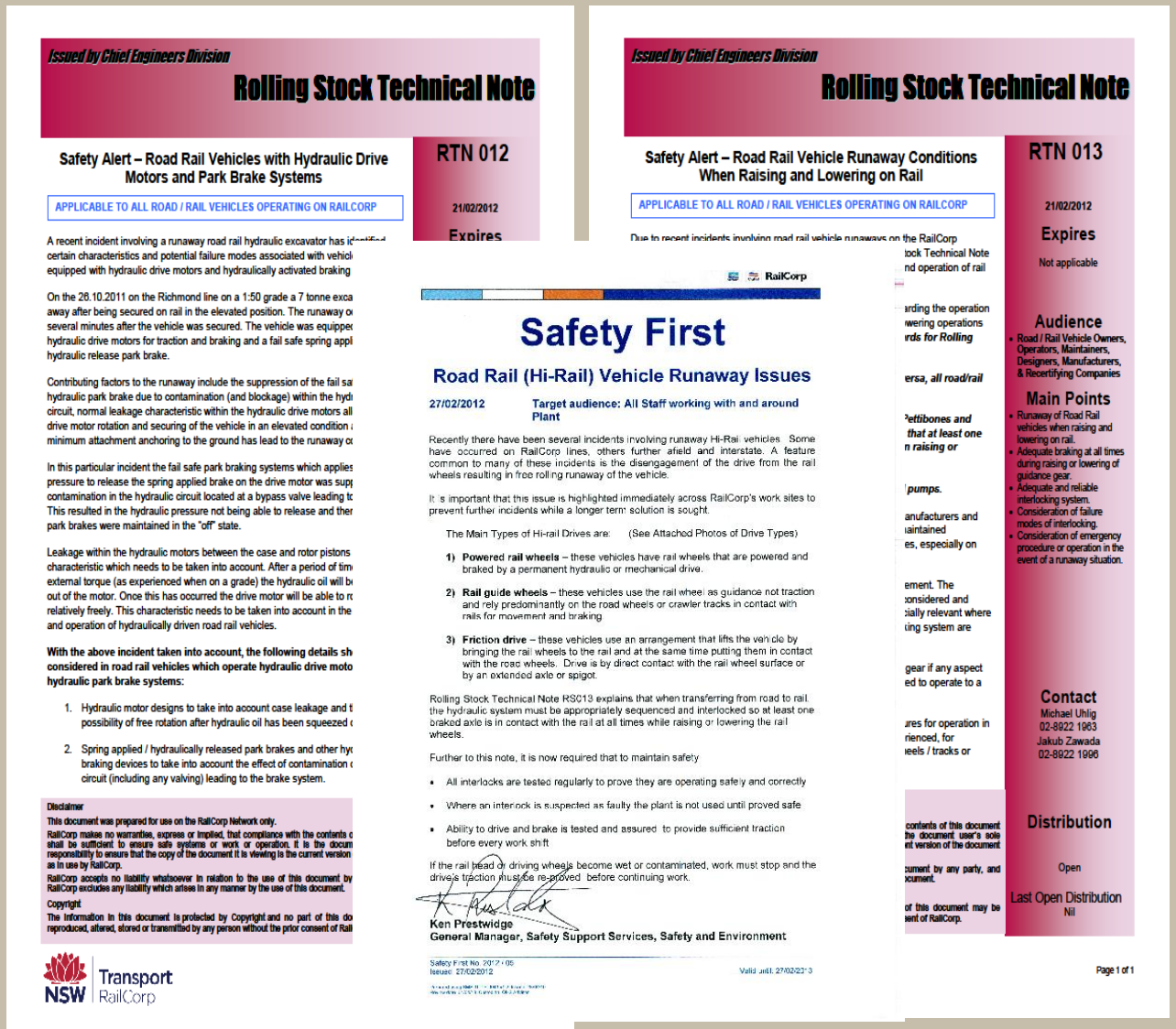
Sect	Cl	Requirement	Type	ML		Poss		R/R		
				N	E	N	E	N	E	ML = train control working, Poss = Possession worl
										N = new/modified, E = existing rolling stock
1.4		**PURPOSE**								
	1	This document describes requirements for compatibility with signalling detection systems.	SUP							Recommend early attention
	2	The main purpose of the requirements is to prevent collisions.	SUP							Recommend medium term action
1.5		**SCOPE**								Other action
	1	This document applies to new and modified infrastructure maintenance rolling stock, and existing infrastructure maintenance rolling stock being proposed for operation in another network.	SUP							Note
	4	The document covers the design, construction and maintenance of rolling stock.	SUP							Note
4.1		**TRACK CIRCUIT SHUNTING**								All items highlighted under New rolling stock should be
4.1.1		**General**								All items highlighted under Existing rolling stock should
	1	UIC Code 737-2 and RSSB Guidance Note GM/GN2576 contain general discussions on track circuit shunting.	SUP							
	2	Infrastructure Maintenance rolling stock that travel outside work closures shall be either detectable or non-detectable in regards to track circuit shunting.	MAN							RailCorp Standard RSU 717 requires compliance with te
	6	Infrastructure maintenance rolling stock when in travel mode shall not leave insulating materials deposited on the rail contact surface to an extent which prevents trains from being detected by the signalling system.	MAN							Maintenance/Operating Procedure required to maintain
	7	Where, in working mode, material is unavoidably deposited on the rail then procedures may need to be put in place to remove the material before the track is released to general traffic.	SUP							
4.1.2		**Detectable Rolling Stock**								
	1	Detectable infrastructure maintenance rolling stock shall have a dc electrical resistance between rail contact surfaces of wheels on the same axle of not greater than 10 mΩ, measured with a voltage source no greater than 300mV.	MAN							Maintenance Procedure required to maintain compliance
	2	Detectable infrastructure maintenance rolling stock should provide the leading and trailing wheelset (the extremity axles) of each vehicle with a means to remove surface contaminants from wheel tread surfaces.	REC							
	4	Detectable infrastructure maintenance rolling stock shall meet the axle load requirements of Table 8.	MAN							See Section 4.1.2.6 of AS 7504.4 for Table
4.1.3		**Non-Detectable Rolling Stock**								
	1	Non-detectable infrastructure maintenance rolling stock shall have a dc electrical resistance between rail contact surfaces of wheels on the same axle of greater than 20,000 Ω.	MAN							Maintenance Procedure required to maintain compliance
4.2		**VEHICLE DIMENSIONS**								
4.2.1		**Overhang**								
	1	The extremities of detectable infrastructure maintenance rolling stock shall not extend longitudinally past the outermost detectable axles by the amount defined in Table 9.	MAN							See Section 4.2.1.2 of AS 7504.4 for Table
4.2.2		**Axle Spacing**								
	1	The distance between the inner axles of adjacent bogies on detectable infrastructure maintenance rolling stock shall not exceed that defined in Table 10.	MAN							See Section 4.2.2.2 of AS 7504.4 for Table
6.3		**LONGITUDINAL VOLTAGE**								
	1	New or modified infrastructure maintenance rolling stock operating over any network utilising DC track circuits shall not be able to cause a longitudinal voltage along a rail between any two wheels exceeding 200 mV rms between 0 and 2.4 Hz.	MAN							
	2	New or modified infrastructure maintenance rolling stock operating over any network utilising AF track circuits shall not be able to cause a longitudinal voltage along a rail between any two wheels exceeding 173mV rms at any of the specific operating frequencies of AF track circuits.	MAN							
	3	New or modified infrastructure maintenance rolling stock operating over any network utilising 50Hz vane relay track circuits shall not be able to cause a longitudinal voltage along a rail between any two wheels exceeding 150mV rms at 50Hz.	MAN							
7		**TESTING**								

FINDINGS

- **STANDARDS FOR ROLLING STOCK LARGELY CENTRED AROUND LOCOS AND WAGONS**
- **A NUMBER OF TRACK MACHINE STANDARDS (PART 4) WERE ALIGNED TO THE ABOVE**
- **STANDARDS RELATING TO HI-RAIL VEHICLES WERE NOT AS CLEARLY DEFINED OR NOT DEFINED AT ALL**
- **A NUMBER OF ROLLING STOCK STANDARDS WERE STILL IN DRAFT**
- **THE MAIN ONE IN DRAFT WAS THE STANDARD FOR BRAKING SYSTEMS (AS 7510)**
- **ALTHOUGH A NUMBER OF DRAFT STANDARDS ADOPTED OTHER STANDARDS WERE ALSO REFERENCED E.G. RAILCORP RSU OR THE ROA MANUAL**
- **LAING O'ROURKE KEEN TO WORK WITH INDUSTRY TO DEVELOP STANDARDS / GUIDELINES TO SUPPLEMENT OTHER MATERIAL**

LAING O'ROURKE

HOWEVER ALERTS WERE STILL BEING ISSUED



Issued by Chief Engineers Division

Rolling Stock Technical Note

Safety Alert – Road Rail Vehicles with Hydraulic Drive Motors and Park Brake Systems

RTN 012

21/02/2012

Expires

APPLICABLE TO ALL ROAD / RAIL VEHICLES OPERATING ON RAILCORP

A recent incident involving a runaway road rail hydraulic excavator has id… certain characteristics and potential failure modes associated with vehicl… equipped with hydraulic drive motors and hydraulically activated braking …

On the 26.10.2011 on the Richmond line on a 1:50 grade a 7 tonne exca… away after being secured on rail in the elevated position. The runaway o… several minutes after the vehicle was secured. The vehicle was equippe… hydraulic drive motors for traction and braking and a fail safe spring appl… hydraulic release park brake.

Contributing factors to the runaway include the suppression of the fail sa… hydraulic park brake due to contamination (and blockage) within the hyd… circuit, normal leakage characteristic within the hydraulic drive motors all… drive motor rotation and securing of the vehicle in an elevated condition … minimum attachment anchoring to the ground has lead to the runaway o…

In this particular incident the fail safe park braking systems which applies… pressure to release the spring applied brake on the drive motor was supp… contamination in the hydraulic circuit located at a bypass valve leading t… This resulted in the hydraulic pressure not being able to release and ther… park brakes were maintained in the "off" state.

Leakage within the hydraulic motors between the case and rotor pistons … characteristic which needs to be taken into account. After a period of tim… external torque (as experienced when on a grade) the hydraulic oil will b… out of the motor. Once this has occurred the drive motor will be able to r… relatively freely. This characteristic needs to be taken into account in the … and operation of hydraulically driven road rail vehicles.

With the above incident taken into account, the following details sh… considered in road rail vehicles which operate hydraulic drive moto… hydraulic park brake systems:

1. Hydraulic motor designs to take into account case leakage and t… possibility of free rotation after hydraulic oil has been squeezed …
2. Spring applied / hydraulically released park brakes and other hy… braking devices to take into account the effect of contamination … circuit (including any valving) leading to the brake system.

Disclaimer

This document was prepared for use on the RailCorp Network only.

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NSW Transport RailCorp

Issued by Chief Engineers Division

Rolling Stock Technical Note

Safety Alert – Road Rail Vehicle Runaway Conditions When Raising and Lowering on Rail

RTN 013

21/02/2012

Expires

Not applicable

APPLICABLE TO ALL ROAD / RAIL VEHICLES OPERATING ON RAILCORP

Due to recent incidents involving road rail vehicle runaways on the RailCorp … tock Technical Note … nd operation of rail …

… erding the operation … wering operations … rds for Rolling …

… ersa, all road/rail …

… ettibones and … that at least one … n raising or …

… pumps. …

… anufacturers and … aintained … es, especially on …

… ement. The … onsidered and … cially relevant where … ing system are …

… gear if any aspect … ed to operate to a …

… res for operation in … rienced, for … eels / tracks or …

Audience

- Road / Rail Vehicle Owners, Operators, Maintainers, Designers, Manufacturers, & Recertifying Companies

Main Points

- Runaway of Road Rail vehicles when raising and lowering on rail.
- Adequate braking at all times during raising or lowering of guidance gear.
- Adequate and reliable interlocking system.
- Consideration of failure modes of interlocking.
- Consideration of emergency procedure or operation in the event of a runaway situation.

Contact

Michael Uhlig
02-8922 1963
Jakub Zawada
02-8922 1996

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Safety First

Road Rail (Hi-Rail) Vehicle Runaway Issues

27/02/2012 **Target audience: All Staff working with and around Plant**

Recently there have been several incidents involving runaway Hi-Rail vehicles. Some have occurred on RailCorp lines, others further afield and interstate. A feature common to many of these incidents is the disengagement of the drive from the rail wheels resulting in free rolling runaway of the vehicle.

It is important that this issue is highlighted immediately across RailCorp's work sites to prevent further incidents while a longer term solution is sought.

The Main Types of Hi-rail Drives are: (See Attached Photos of Drive Types)

1) **Powered rail wheels** – these vehicles have rail wheels that are powered and braked by a permanent hydraulic or mechanical drive.
2) **Rail guide wheels** – these vehicles use the rail wheel as guidance not traction and rely predominantly on the road wheels or crawler tracks in contact with rails for movement and braking.
3) **Friction drive** – these vehicles use an arrangement that lifts the vehicle by bringing the rail wheels to the rail and at the same time putting them in contact with the road wheels. Drive is by direct contact with the rail wheel surface or by an extended axle or spigot.

Rolling Stock Technical Note RS013 explains that when transferring from road to rail the hydraulic system must be appropriately sequenced and interlocked so at least one braked axle is in contact with the rail at all times while raising or lowering the rail wheels.

Further to this note, it is now required that to maintain safety:

- All interlocks are tested regularly to prove they are operating safely and correctly
- Where an interlock is suspected as faulty the plant is not used until proved safe
- Ability to drive and brake is tested and assured to provide sufficient traction before every work shift

If the rail head or driving wheels become wet or contaminated, work must stop and the drive's traction must be re-proved before continuing work.

Ken Prestwidge
General Manager, Safety Support Services, Safety and Environment

Safety First No. 2012 / 05
Issued: 27/02/2012

Valid until: 27/02/2013

Page 1 of 1

INDEPENDENT TRANSPORT SAFETY REGULATOR
Safe transport for NSW

Transport safety alert

Transport safety alerts are published by ITSR under section 42L(2) of the *Transport Administration Act 1988* to promote the safe operation of transport services.

Transport safety alerts are intended to provide information only and must be read in connection with obligations under relevant legislation.

22 March 2012 | TSA no. 39

Effective operation and management of hi-rail equipment

Road/Rail Vehicles are to have effective

- systems for securing during transitioning between travel modes or stowage
- braking capacity during rail movements, and
- management of rail guidance equipment.

Background

In the past, manufacturers (including OEMs) and ancillary equipment suppliers have developed road rail vehicles (RRVs), essentially, in response to market opportunities. Furthermore, Rail Infrastructure Managers (RIMs) have provided only minimal input into the management of the different stages of an RRV's life cycle starting from defining the concept design requirements through to the decommissioning process. As a result, there has been a proliferation of different types of rail plant and in some cases, this has been compounded by modifications to the RRVs, that may not have been optimised for the tasks intended to be carried out, or specified to a level that would have ensured an acceptable degree of safety.

A number of recent RRV incidents have resulted in either runaways and/or derailments due to the loss of braking capacity, the application of an insufficient braking force or the failure of the rail guidance equipment. In addition to issues concerning the inadequacy of the training and competency assessment process for RRV operators, these incidents have also highlighted the following safety concerns (grouped by category), namely:

- absence of sufficient braking force (whilst transitioning or during stowage)
  - hydraulically operated spring park brakes (or handbrakes) may lose their braking capacity as a result of blockages in the hydraulic system (due to the ingress of debris, particularly when changing attachments);
  - hydraulically driven motors may exhibit sufficient oil leakage to allow the pistons to retract and the motors to then free wheel;
  - RRVs that (through modification or otherwise) incorporate an inappropriate wiring (electrical) arrangement, may, negate any traction interlocking function and allow the vehicle to free wheel whilst transitioning between travel modes; and
  - RRVs in which the hi-rail wheels are driven and braked by friction forces transmitted through the road (rubber) tyres, such as via hub extensions to the rail wheels, have experienced unintended movement on rail when transitioning between road and rail modes due to the application of an insufficient braking force.

DISC BRAKES WERE ORDERED FOR RRV HI-RAIL

INDEPENDENT TRANSPORT SAFETY REGULATOR

Notification form

www.transportregulator.nsw.gov.au

Change to railway operations

Note: A notification under clause 22(2) of the *Rail Safety (General) Regulation 2008* is a condition of accreditation. Accredited persons are bound by the *Rail Safety Act 2008* to comply with conditions of their accreditation.

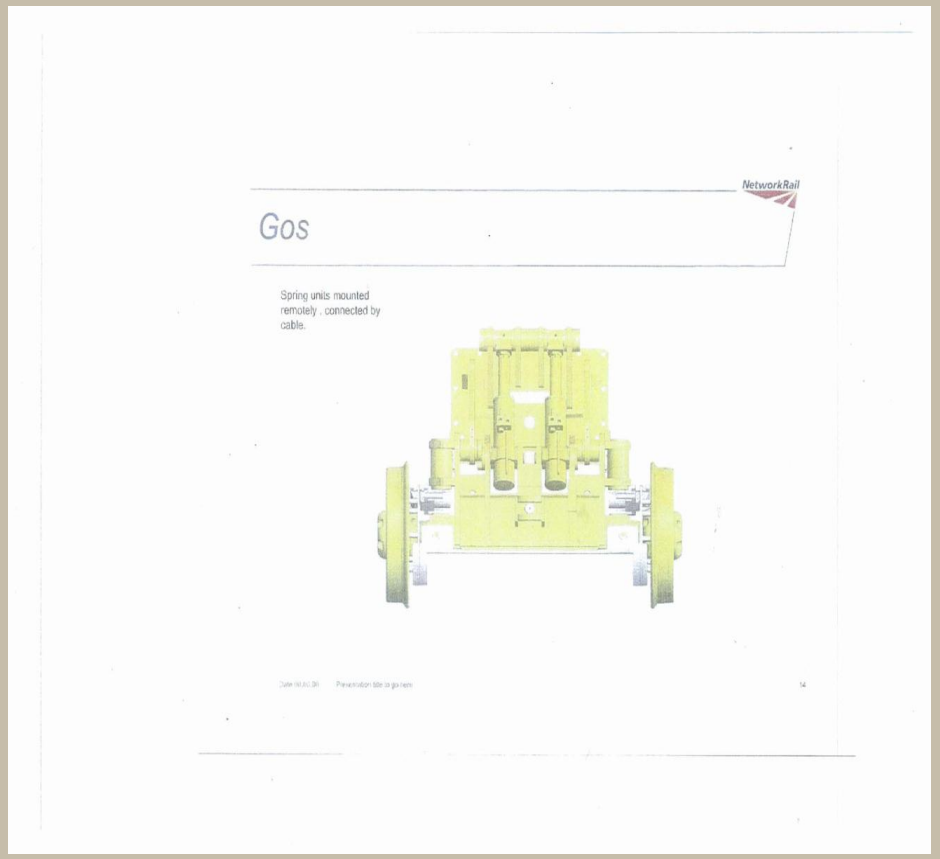
* An extract of clause 22 of the regulation is on page 3 of this form.

Instructions

- Completed forms can be forwarded to ITSR either by **email:** [illegible] transportregulator.nsw.gov.au or **fax:** 02 8262 7700.
- Identify the notification type. The notification type is a reference to the decision, event or change listed in column 2 of the table to clause 22(2) of the regulation. For example, an item 17 notification refers to a modification of a decision to design or construct, or to commission the design or construction of, rolling stock or new railway tracks.
- Provide a short description of the decision, event or change, eg. "decision to construct a new railway track at XX location".
- Provide the proposed commencement date of the decision, event or change.
- If Provide details of the consultation undertaken in relation to the decision, event or change. Please note clause 22(3) of the Regulation requires details on:
  (1) the persons consulted
  (2) when and how they were consulted
  (3) the results of the consultation.
- The contact person under clause 22(3)(a) of the Regulation signs the notification form.
- If submitting notification within the required timeframes set down in column 3 of the table to clause 22(2) of the Regulation for the applicable decision, event or change identified in column 2 of the table.

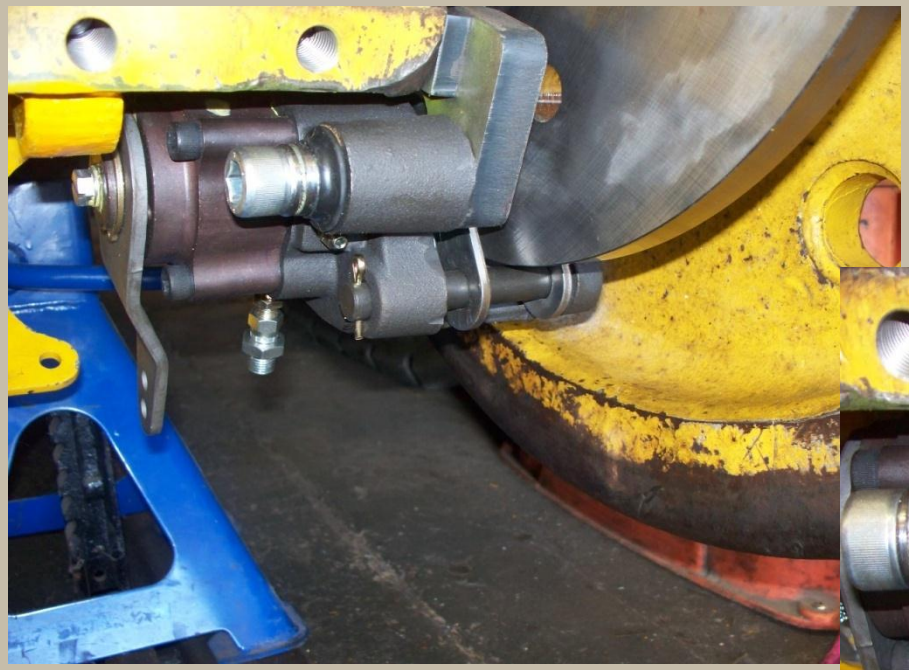
If it is not possible to comply with the regulation timeframes because of an emergency, you must provide the required information as soon as reasonably practicable after the decision is made or the event or change occurs, as the case requires.

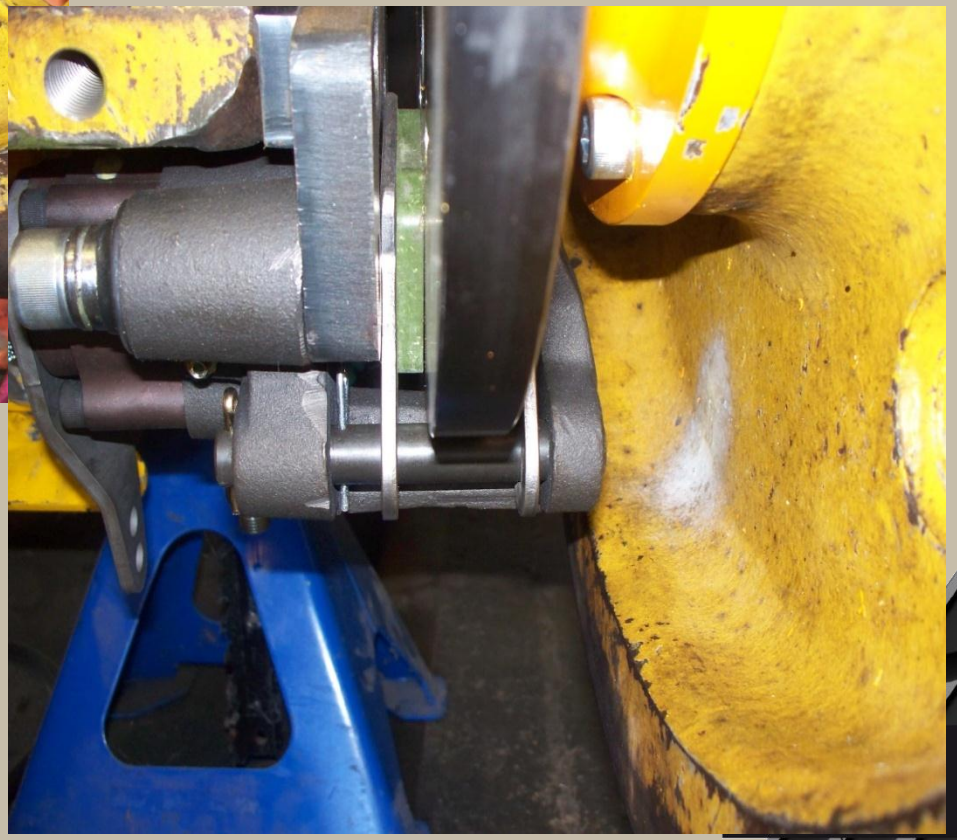
ITSR



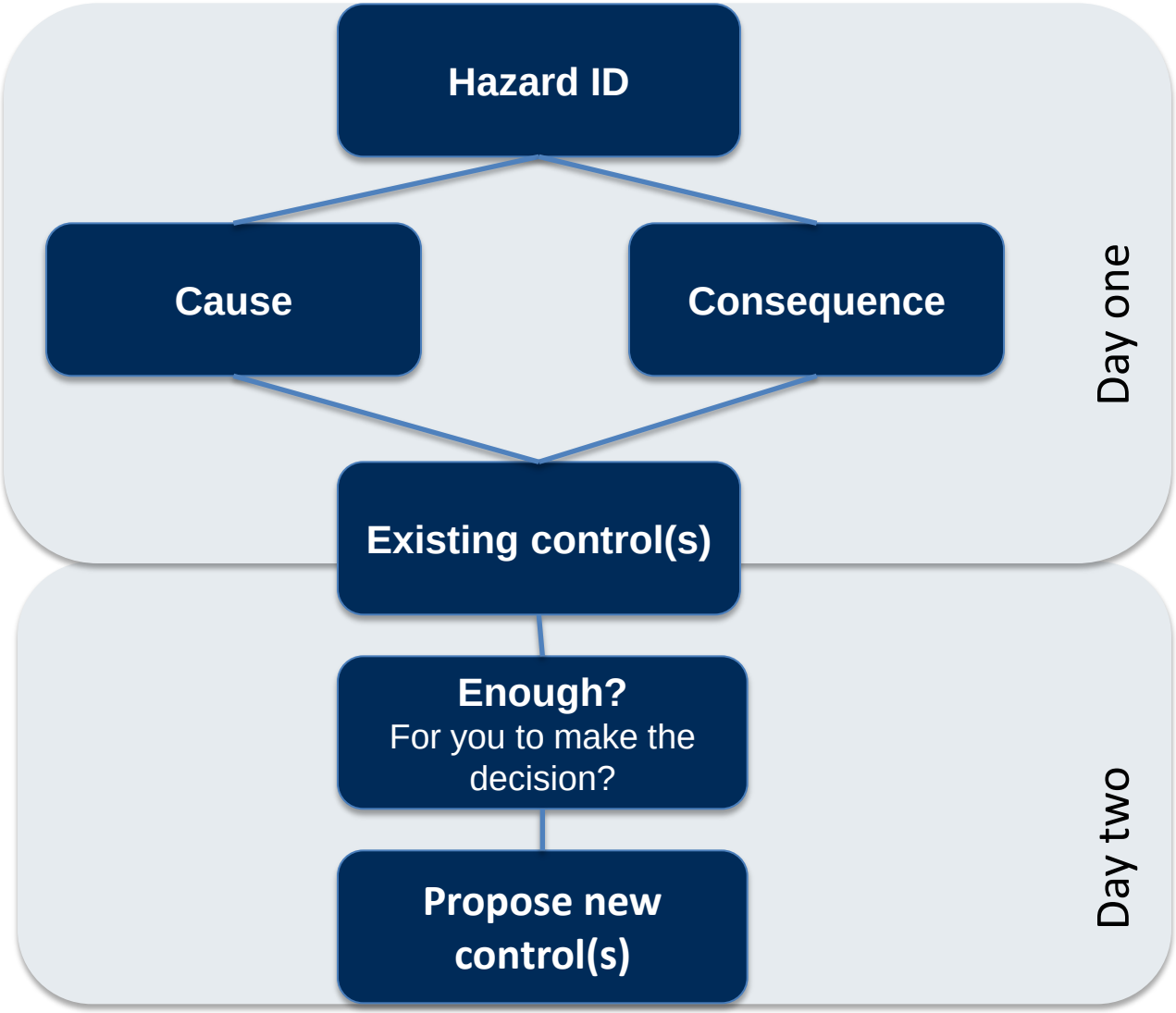
LAING O'ROURKE

ON RECEIPT AND FOLLOWING SOME ISSUES THEY WERE PROGRESSIVELY FITTED





Process Summary



Actions required to improve safe operations

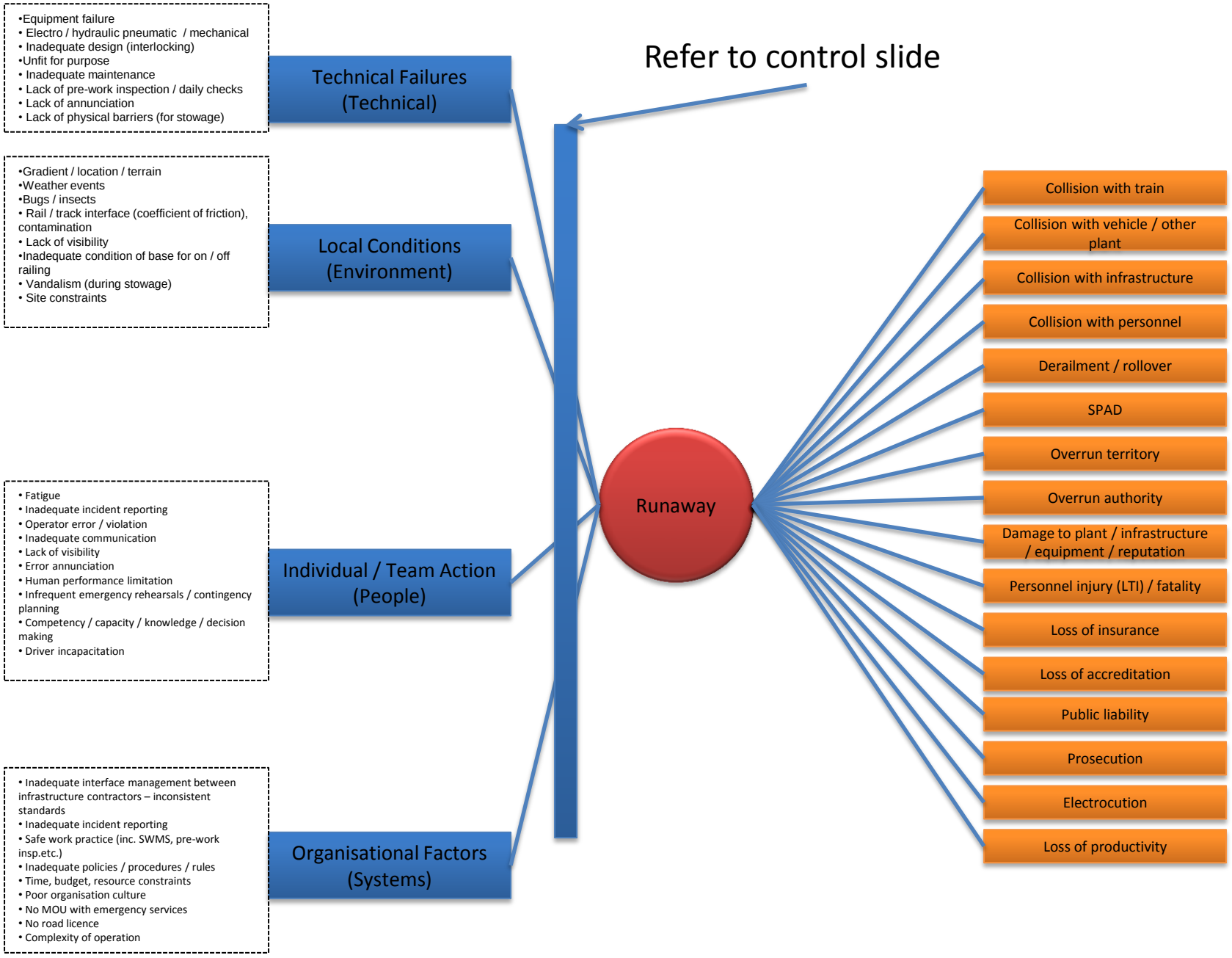
PHA results, Bow tie & actions

Wednesday 31 October 2012

Jesse Baker, Alex Borodin, Lindsay Holt, Adrian Rowland

PHA RESULTS & BOW TIE

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Runaway	Technical (technical failures) • Equipment failure [Control ID: 1, 2, 3, 5, 6, 7, 8, 12, 14, 20, 22, 23, 24, 25, 26, 32, 33, 35, 36, 38] • Electro / hydraulic pneumatic / mechanical • Inadequate design (interlocking) [Control ID: 2, 3, 5, 39, 9, 11, 12, 18, 32, 33] •Unfit for purpose [Control ID: 1, 2, 3, 5, 6, 7, 9, 12, 14, 18, 22, 32, 33, 38, 39] • Inadequate maintenance [Control ID: 1, 5, 6, 7, 8, 9, 10 ,11, 12, 13, 18, 32, 33, 38, 39] • Lack of pre-work inspection / daily checks [Control ID: 1, 6, 7, 8, 9, 10, 11, 13, 18, 38, 39] • Lack of annunciation [Control ID: 2, 3, 5, 6, 7, 9, 10, 11, 12, 13] • Lack of physical barriers (for stowage) [Control ID: 1, 6, 10, 13, 15, 16, 18, 21, 22, 23, 24, 38] Environment (local conditions) • Gradient / location / terrain [Control ID: 1, 4, 5, 6, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 29, 31, 32, 33, 35, 36, 37, 38] • Weather events [Control ID: 1, 10, 13, 16, 17, 18 ,19, 26, 30, 35, 37, 38] • Bugs / insects [Control ID: as per weather events] • Rail / track interface (coefficient of friction), contamination [Control ID: 1, 2, 3, 6, 7, 9, 10, 14, 16, 17, 18, 21, 23, 24, 26, 35, 36, 37, 38, 39] • Lack of visibility [Control ID: 12, 10, 14, 15, 16, 17, 18, 19, 21, 26, 30, 31, 37, 38, 39] • Inadequate condition of base for on / off railing [Control ID: 1, 2, 3, 7, 9, 10, 14, 16, 18, 20, 21, 26, 30, 32, 35, 36, 38, 39] • Vandalism (during stowage) [Control ID: 1, 2, 3, 9, 10, 18, 21, 22, 23, 24, 21] • Site constraints [Control ID: 1, 2, 3, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 30, 31, 35, 36, 37, 38, 39] People (individual / team actions) • Fatigue [Control ID: 1, 8, 10, 13, 15, 34, 38] • Inadequate incident reporting [Control ID: 1, 5, 9, 10, 11, 13, 14, 18, 33, 38] • Operator error / violation [Control ID: 1, 5, 6, 8, 9, 10, 13, 15, 16, 17, 18, 20, 21, 25, 26, 27, 30, 33, 35, 36, 37] • Inadequate communication [Control ID: 1, 5, 6, 10, 12, 13, 19, 30, 38, 15] • Lack of visibility (???) • Error annunciation (???) • Human performance limitation (???) • Infrequent emergency rehearsals / contingency planning [Control ID: 1, 2, 5, 10, 13, 23, 37, 38] • Competency / capacity / knowledge / decision making [Control ID: 1, 5, 8, 10, 13, 38] • Driver incapacitation [Control ID: 1, 3, 5, 8, 10, 13, 36, 38] Systems (organisational factors) • Inadequate interface management between infrastructure contractors – inconsistent standards [Control ID: 1, 2, 4, 5, 6, 7, 11, 14, 16] • Inadequate incident reporting [Control ID: 1, 5, 10, 11] • Safe work practice (inc. SWMS, pre-work insp.etc.) [Control ID: 1, 4, 5, 18, 10, 11] • Inadequate policies / procedures / rules [Control ID: 1, 11, 16, 18] • Time, budget, resource constraints [Control ID: 1, 2, 6, 7, 12, 14, 33] • Poor organisation culture [Control ID: 11, 13, 18, 1, 4, 5, 10, 15, 38] • No MOU with emergency services [Control ID: 1, 6, 4, 5, 10, 11, 14, 18] • No road licence [Control ID: 1, 5, 6, 10, 13, 38] • Complexity of operation [Control ID: 1, 5, 7, 9, 10, 13, 38]	•Collision with train / vehicle / other plant / infrastructure / personnel •Derailment / rollover •SPAD •Overrun territory •Overrun authority •Damage to plant, equipment, infrastructure, reputation •Personnel injury (LTI) / fatality •Loss of insurance / accreditation •Public liability •Prosecution •Electrocution •Loss to productivity	1. SOPs / JSAs / SWMS / Management standards 2. Technical and performance specifications 3. Design input 4. Accreditation of organisation / equipment 5. Technical registration / certification / training 6. System checks – sampling of procedural controls 7. Long-term monitoring 8. Fatigue, D&A management program 9. Maintenance / inspection schedules & plans 10. Inductions 11. Industry / regulator interactions / alerts 12. Procurement processes 13. People management – discipline arrangements / training / culture 14. Interface management 15. Possession management / coordination / network registration 16. Network rules 17. Route competency 18. Workplace inspections / management 19. Secondary / alternate comms. 20. Derailers / level crossing infrastructure 21. Catch points / derailers 22. Site security (for stowage) 23. Chocks for stowage (for stowage) 24. Stow vehicle off-track 25. derailers, skids, speed limiters 26. braking systems 27. speed board 28. data logger 29. GPS tracking 30. Comms. Protocols 31. Train protection 32. Asset lifecycle management 33. Change management 34. Health standards 35. on/off track pads 36. interlocks 37. Weather monitoring 38. supervision 39. Rail safety investications 40. Driver safety systems	


•Equipment failure
• Electro / hydraulic pneumatic / mechanical
• Inadequate design (interlocking)
•Unfit for purpose
• Inadequate maintenance
• Lack of pre-work inspection / daily checks
• Lack of annunciation
• Lack of physical barriers (for stowage)
Technical Failures (Technical)
Refer to control slide
•Gradient / location / terrain
•Weather events
•Bugs / insects
• Rail / track interface (coefficient of friction), contamination
• Lack of visibility
•Inadequate condition of base for on / off railing
• Vandalism (during stowage)
• Site constraints
Local Conditions (Environment)
• Fatigue
• Inadequate incident reporting
• Operator error / violation
• Inadequate communication
• Lack of visibility
• Error annunciation
• Human performance limitation
• Infrequent emergency rehearsals / contingency planning
• Competency / capacity / knowledge / decision making
• Driver incapacitation
Individual / Team Action (People)
• Inadequate interface management between infrastructure contractors – inconsistent standards
• Inadequate incident reporting
• Safe work practice (inc. SWMS, pre-work insp.etc.)
• Inadequate policies / procedures / rules
• Time, budget, resource constraints
• Poor organisation culture
• No MOU with emergency services
• No road licence
• Complexity of operation
Organisational Factors (Systems)
Runaway
Collision with train
Collision with vehicle / other plant
Collision with infrastructure
Collision with personnel
Derailment / rollover
SPAD
Overrun territory
Overrun authority
Damage to plant / infrastructure / equipment / reputation
Personnel injury (LTI) / fatality
Loss of insurance
Loss of accreditation
Public liability
Prosecution
Electrocution
Loss of productivity

Runaway control slide

Technical (technical failures)

- Equipment failure [Control ID: 1, 2, 3, 5, 6, 7, 8, 12, 14, 20, 22, 23, 24, 25, 26, 32, 33, 35, 36, 38]
  - Electro / hydraulic pneumatic / mechanical
- Inadequate design (interlocking) [Control ID: 2, 3, 5, 39, 9, 11, 12, 18, 32, 33]
- Unfit for purpose [Control ID: 1, 2, 3, 5, 6, 7, 9, 12, 14, 18, 22, 32, 33, 38, 39]
- Inadequate maintenance [Control ID: 1, 5, 6, 7, 8, 9, 10 ,11, 12, 13, 18, 32, 33, 38, 39]
- Lack of pre-work inspection / daily checks [Control ID: 1, 6, 7, 8, 9, 10, 11, 13, 18, 38, 39]
- Lack of annunciation [Control ID: 2, 3, 5, 6, 7, 9, 10, 11, 12, 13]
- Lack of physical barriers (for stowage) [Control ID: 1, 6, 10, 13, 15, 16, 18, 21, 22, 23, 24, 38]

Environment (local conditions)

- Gradient / location / terrain [Control ID: 1, 4, 5, 6, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 29, 31, 32, 33, 35, 36, 37, 38]
- Weather events [Control ID: 1, 10, 13, 16, 17, 18 ,19, 26, 30, 35, 37, 38]
- Bugs / insects [Control ID: as per weather events]
- Rail / track interface (coefficient of friction), contamination [Control ID: 1, 2, 3, 6, 7, 9, 10, 14, 16, 17, 18, 21, 23, 24, 26, 35, 36, 37, 38, 39]
- Lack of visibility [Control ID: 12, 10, 14, 15, 16, 17, 18, 19, 21, 26, 30, 31, 37, 38, 39]
- Inadequate condition of base for on / off railing [Control ID: 1, 2, 3, 7, 9, 10, 14, 16, 18, 20, 21, 26, 30, 32, 35, 36, 38, 39]
- Vandalism (during stowage) [Control ID: 1, 2, 3, 9, 10, 18, 21, 22, 23, 24, 21]
- Site constraints [Control ID: 1, 2, 3, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 30, 31, 35, 36, 37, 38, 39]

People (individual / team actions)

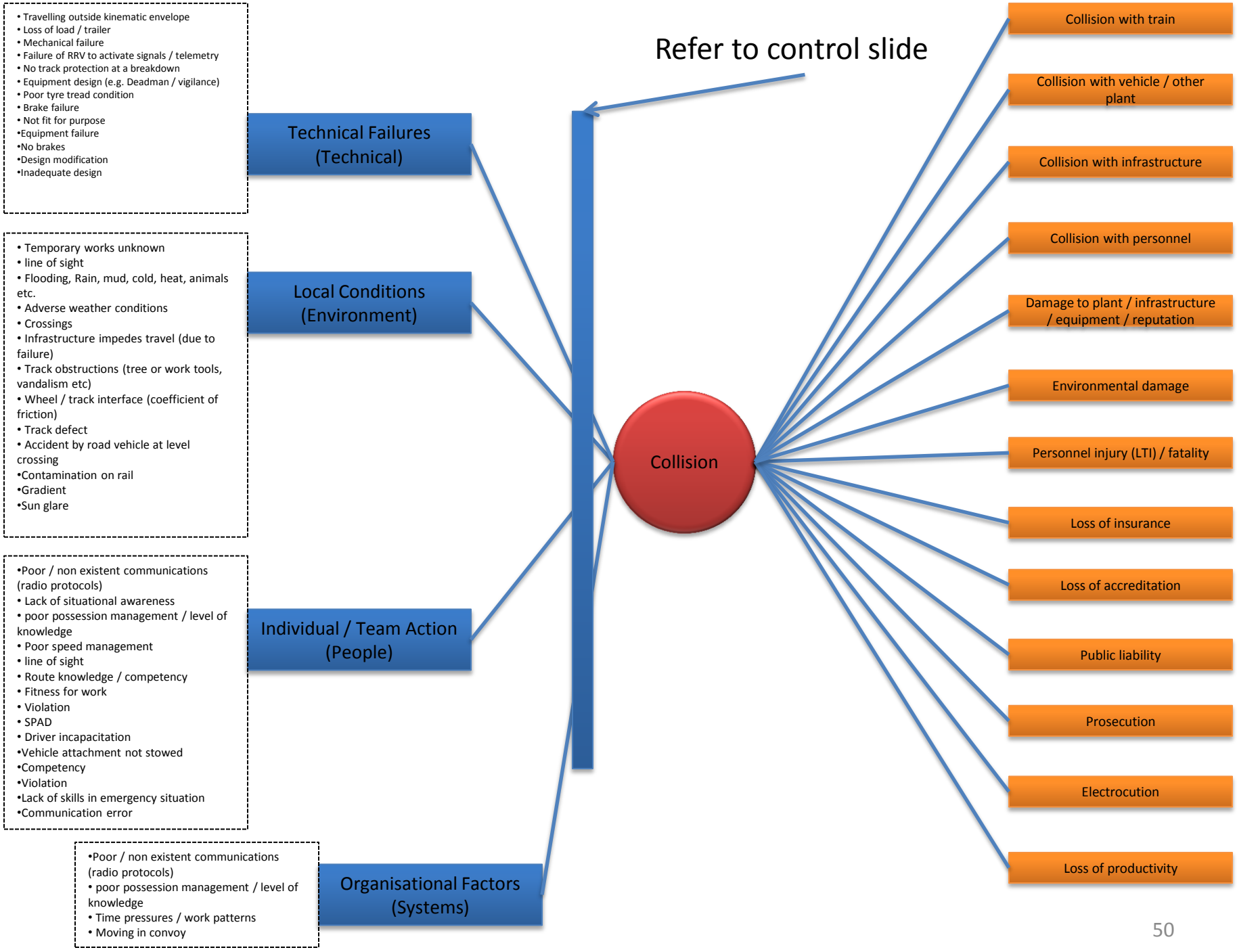
- Fatigue [Control ID: 1, 8, 10, 13, 15, 34, 38]
- Inadequate incident reporting [Control ID: 1, 5, 9, 10, 11, 13, 14, 18, 33, 38]
- Operator error / violation [Control ID: 1, 5, 6, 8, 9, 10, 13, 15, 16, 17, 18, 20, 21, 25, 26, 27, 30, 33, 35, 36, 37]
- Inadequate communication [Control ID: 1, 5, 6, 10, 12, 13, 19, 30, 38, 15]
- Lack of visibility (???)
- Error annunciation (???)
- Human performance limitation (???)
- Infrequent emergency rehearsals / contingency planning [Control ID: 1, 2, 5, 10, 13, 23, 37, 38]
- Competency / capacity / knowledge / decision making [Control ID: 1, 5, 8, 10, 13, 38]
- Driver incapacitation [Control ID: 1, 3, 5, 8, 10, 13, 36, 38]

Systems (organisational factors)

- Inadequate interface management between infrastructure contractors – inconsistent standards [Control ID: 1, 2, 4, 5, 6, 7, 11, 14, 16]
- Inadequate incident reporting [Control ID: 1, 5, 10, 11]
- Safe work practice (inc. SWMS, pre-work insp.etc.) [Control ID: 1, 4, 5, 18, 10, 11]
- Inadequate policies / procedures / rules [Control ID: 1, 11, 16, 18]
- Time, budget, resource constraints [Control ID: 1, 2, 6, 7, 12, 14, 33]
- Poor organisation culture [Control ID: 11, 13, 18, 1, 4, 5, 10, 15, 38]
- No MOU with emergency services [Control ID: 1, 6, 4, 5, 10, 11, 14, 18]
- No road licence [Control ID: 1, 5, 6, 10, 13, 38]
- Complexity of operation [Control ID: 1, 5, 7, 9, 10, 13, 38]

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Collision	<u>Technical (technical failures)</u> • Travelling outside kinematic envelope [Control ID: 1, 2, 5, 10, 8, 17, 20, 25] • Loss of load / trailer [Control ID: 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17, 19, 20, 22, 23, 25] • Mechanical failure [Control ID: 1, 2, 3, 5, 6, 10, 13, 15, 17, 18, 19, 20, 25] • Failure of RRV to activate signals / telemetry [Control ID: 1, 2, 3, 5, 7, 8, 10, 17, 19, 20, 25] • No track protection at a breakdown [Control ID: 1, 2, 3, 8, 17, 18, 20, 25] • Equipment design (e.g. Deadman / vigilance) [Control ID: 1, 2, 4, 5, 8, 10, 13, 15, 19, 20] • Poor tyre tread condition [Control ID: 1, 2, 3, 4, 5, 6, 8, 10, 13, 17, 19, 20, 23, 24, 25] • Brake failure [Control ID: 1, 2, 3, 5, 6, 10, 13, 15, 17, 18, 19, 20, 24, 25] • Not fit for purpose [Control ID: 1, 3, 2, 4, 5, 8, 10, 13, 15, 19, 20] <u>Environment (local conditions)</u> • Temporary works unknown [Control ID: 1, 2, 3, 6, 8, 9, 12, 13, 20, 17, 25, 14] • line of sight [Control ID: 1, 2, 3, 5, 6, 8, 9, 10, 12, 17, 20, 21, 24, 25] • Flooding, Rain, mud, cold, heat, animals etc. [Control ID: 2, 24, 4, 6, 21, 8, 10, 12 , 13, 14, 20, 17, 24, 25] • Adverse weather conditions [Control ID: Refer to flooding etc.] • Crossings [Control ID: 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17, 18, 20, 24, 25] • Infrastructure impedes travel (due to failure) [Control ID: 1, 2, 3, 6, 8, 12, 14, 17, 18, 20, 25] • Track obstructions (tree or work tools, vandalism etc) [Control ID: 2, 3, 6, 8, 12, 13, 17, 20, 25] • Wheel / track interface (coefficient of friction) [Control ID: 1, 2, 3, 4, 5, 6, 8, 9, 12, 10, 13, 17, 19, 25, 20, 24, 23] • Track defect [Control ID: 1, 2, 3, 4, 5, 6, 14, 8, 12, 17, 19, 20, 25, 24] <u>People (individual / team actions)</u> • Poor / non existent communications (radio protocols) [Control ID: 3, 17,8 ,10, 16, 25] • Lack of situational awareness [Control ID: 16, 8, 17, 21, 25, 24] • poor possession management / level of knowledge [Control ID: 25, 3, 8, 17, 18] • Poor speed management [Control ID: 6, 21, 3, 15, 16, 14, 24, 25] • line of sight [Control ID: 9, 6, 24, 8, 11, 21] • Route knowledge / competency [Control ID: 3, 6, 8, 14, 24, 25] • Fitness for work [Control ID: 3, 21, 25] • Violation [Control ID: 3, 8, 21, 6, 14, 15, 25, 17, 20] • SPAD [Control ID: 3, 6, 7, 5, 21, 8, 13, 18, 17, 25, 24] • Driver incapacitation [Control ID: 7, 21, 25] •Vehicle attachment not stowed [Control ID: 2, 3, 6, 8, 5, 23, 9, 10] <u>Systems (organisational factors)</u> • Poor / non existent communications (radio protocols) [Control ID: 8, 17, 18, 3, 5] • poor possession management / level of knowledge [Control ID: 3, 8, 20, 17, 25, 18] • Time pressures / work patterns [Control ID: 8, 20, 21, 25, 3] • Moving in convoy [Control ID: 1, 3, 6, 5, 10, 8, 9, 17, 12, 14, 25, 24, 18, 7]	•Environmental damage •Collision with train / vehicle / other plant / infrastructure / personnel •Derailment / rollover •SPAD •Overrun territory •Overrun authority •Damage to plant, equipment, infrastructure, reputation •Personnel injury (LTI) / fatality •Loss of insurance / accreditation •Public liability •Prosecution •Electrocution •Loss to productivity	1. OEM / RIM standards 2. Visual inspections 3. training 4. weight guides 5. vehicle maintenance 6. driving to conditions 7. vigilance system 8. Rules & procedures 9. Cameras, audible alarms (some RRVs) 10. Maintenance 11. 6m Rule (some) 12. 15km/h limit (some) 13. braking systems 14. speed board 15. data logger 16. GPS tracking 17. Comms. Protocols 18. Train protection and worksite protection 19. Asset lifecycle management 20. Change management 21. Health standards / fatigue management 22. on/off track pads 23. interlocks 24. Weather monitoring 25. supervision	Separation alarm systems All trailers brake system fitted Clarification of where vigilance control systems are required Clarify design consistency needs (RIM/OEM, engineering issues) Proximity sensors Audible alarms (loss of traction (better alarms automated)) Coupling rules (physical connections rules in context with equipment) Emergency response (expanded scenarios)

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Collision (specific to off rail)	Technical (technical failures) [Control ID: 7, 8] •Equipment failure •No brakes •Design modification •Inadequate design Environment (local conditions) [Control ID: 1, 3] • Accident by road vehicle at level crossing •Contamination on rail •Gradient •Sun glare People (individual / team actions) • Travelling in convoy (poor communication protocol) [Control ID: 6, 7] • Not sticking to plan [Control ID: 6, 7] • Not competent on type of equipment [Control ID: 5] • Not questioning authority if in doubt (safety culture) [Control ID: 3] • Violations [Control ID: 1, 3, 5, 6, 7] •Fitness for duty – fatigue, D&A, incapacitation Systems (organisational factors) •Inadequate training processes [Control ID: 4, 5, 7, 8] •Inadequate procedures [Control ID: 9, 10] •Inadequate standards [Control ID: 9, 10] •Production demands [Control ID: 6, 7, 8, 9, 10] •Inadequate resourcing [Control ID: 5, 11] •Not competent on type of equipment [Control ID: 4, 5, 7, 8] • Inadequate change management [Control ID: 3, 7, 6]	•Environmental damage •Collision with train / vehicle / other plant / infrastructure / personnel •Derailment / rollover •SPAD •Overrun territory •Overrun authority •Damage to plant, equipment, infrastructure, reputation •Personnel injury (LTI) / fatality •Loss of insurance / accreditation •Public liability •Prosecution •Electrocution •Loss to productivity •Delayed emergency services •Delay of services •Fire	1. Protection/Safeworking 2. Education 3. Communication 4. Up skilling 5. competencies 6. Network rules 7. Procedures 8. Standards 9. Project review 10. SMS review 11. Resourcing capacity 12. Fit to task / people / equipment	
RRV Collision (specific to emergency off rail)	Technical (technical failures) [Control ID: 6, 8] • Unable to move machine •No brakes •Design modification •Inadequate design Environment (local conditions) [Control ID:1, 4, 6, 2] • Off rail at non specified location / inappropriate location • contamination •Gradient •visibility • Terrain / infrastructure problem • Washaway • Bushfires / snow People (individual / team actions) [Control ID: 1, 2, 3, 4, 5, 6, 7, 8, 9] •Competency •Violation •Lack of skills in emergency situation •Communication error Systems (organisational factors) • Safe work component [Control ID: 1, 2] • Inadequate consideration of all aspects of an “emergency” [Control ID: 1, 2, 3, 4] • production demands [Control ID: 1, 2, 7] •Inadequate training procedures [Control ID: 3, 6] •Inadequate resourcing [Control ID: 9, 6] •Inadequate procedure [Control ID: 10]	•Environmental damage •Collision with train / vehicle / other plant / infrastructure / personnel •Derailment / rollover •SPAD •Overrun territory •Overrun authority •Damage to plant, equipment, infrastructure, reputation •Personnel injury (LTI) / fatality •Loss of insurance / accreditation •Public liability •Prosecution •Electrocution •Loss to productivity •Delayed emergency services •Delay of services •Fire	1. Protection / safetyworking 2. Communication 3. Training 4. Competencies 5. Fit to task / PPL and equipment 6. Procedures 7. Network rules 8. Engineering standards 9. Resourcing 10. SMS review	


• Travelling outside kinematic envelope
• Loss of load / trailer
• Mechanical failure
• Failure of RRV to activate signals / telemetry
• No track protection at a breakdown
• Equipment design (e.g. Deadman / vigilance)
• Poor tyre tread condition
• Brake failure
• Not fit for purpose
•Equipment failure
•No brakes
•Design modification
•Inadequate design
Technical Failures (Technical)
• Temporary works unknown
• line of sight
• Flooding, Rain, mud, cold, heat, animals etc.
• Adverse weather conditions
• Crossings
• Infrastructure impedes travel (due to failure)
• Track obstructions (tree or work tools, vandalism etc)
• Wheel / track interface (coefficient of friction)
• Track defect
• Accident by road vehicle at level crossing
•Contamination on rail
•Gradient
•Sun glare
Local Conditions (Environment)
•Poor / non existent communications (radio protocols)
• Lack of situational awareness
• poor possession management / level of knowledge
• Poor speed management
• line of sight
• Route knowledge / competency
• Fitness for work
• Violation
• SPAD
• Driver incapacitation
•Vehicle attachment not stowed
•Competency
•Violation
•Lack of skills in emergency situation
•Communication error
Individual / Team Action (People)
•Poor / non existent communications (radio protocols)
• poor possession management / level of knowledge
• Time pressures / work patterns
• Moving in convoy
Organisational Factors (Systems)
Refer to control slide
Collision
Collision with train
Collision with vehicle / other plant
Collision with infrastructure
Collision with personnel
Damage to plant / infrastructure / equipment / reputation
Environmental damage
Personnel injury (LTI) / fatality
Loss of insurance
Loss of accreditation
Public liability
Prosecution
Electrocution
Loss of productivity

Collision control slide

Technical (technical failures)

- Travelling outside kinematic envelope [Control ID: 1, 2, 5, 10, 8, 17, 20, 25]
- Loss of load / trailer [Control ID: 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17, 19, 20, 22, 23, 25]
- Mechanical failure [Control ID: 1, 2, 3, 5, 6, 10, 13, 15, 17, 18, 19, 20, 25]
- Failure of RRV to activate signals / telemetry [Control ID: 1, 2, 3, 5, 7, 8, 10, 17, 19, 20, 25]
- No track protection at a breakdown [Control ID: 1, 2, 3, 8, 17, 18, 20, 25]
- Equipment design (e.g. Deadman / vigilance) [Control ID: 1, 2, 4, 5, 8, 10, 13, 15, 19, 20]
- Poor tyre tread condition [Control ID: 1, 2, 3, 4, 5, 6, 8, 10, 13, 17, 19, 20, 23, 24, 25]
- Brake failure [Control ID: 1, 2, 3, 5, 6, 10, 13, 15, 17, 18, 19, 20, 24, 25]
- Not fit for purpose [Control ID: 1, 3, 2, 4, 5, 8, 10, 13, 15, 19, 20]

Environment (local conditions)

- Temporary works unknown [Control ID: 1, 2, 3, 6, 8, 9, 12, 13, 20, 17, 25, 14]
- line of sight [Control ID: 1, 2, 3, 5, 6, 8, 9, 10, 12, 17, 20, 21, 24, 25]
- Flooding, Rain, mud, cold, heat, animals etc. [Control ID: 2, 24, 4, 6, 21, 8, 10, 12 , 13, 14, 20, 17, 24, 25]
- Adverse weather conditions [Control ID: Refer to flooding etc.]
- Crossings [Control ID: 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 17, 18, 20, 24, 25]
- Infrastructure impedes travel (due to failure) [Control ID: 1, 2, 3, 6, 8, 12, 14, 17, 18, 20, 25]
- Track obstructions (tree or work tools, vandalism etc) [Control ID: 2, 3, 6, 8, 12, 13, 17, 20, 25]
- Wheel / track interface (coefficient of friction) [Control ID: 1, 2, 3, 4, 5, 6, 8, 9, 12, 10, 13, 17, 19, 25, 20, 24, 23]
- Track defect [Control ID: 1, 2, 3, 4, 5, 6, 14, 8, 12, 17, 19, 20, 25, 24]

People (individual / team actions)

- Poor / non existent communications (radio protocols) [Control ID: 3, 17,8 ,10, 16, 25]
- Lack of situational awareness [Control ID: 16, 8, 17, 21, 25, 24]
- poor possession management / level of knowledge [Control ID: 25, 3, 8, 17, 18]
- Poor speed management [Control ID: 6, 21, 3, 15, 16, 14, 24, 25]
- line of sight [Control ID: 9, 6, 24, 8, 11, 21]
- Route knowledge / competency [Control ID: 3, 6, 8, 14, 24, 25]
- Fitness for work [Control ID: 3, 21, 25]
- Violation [Control ID: 3, 8, 21, 6, 14, 15, 25, 17, 20]
- SPAD [Control ID: 3, 6, 7, 5, 21, 8, 13, 18, 17, 25, 24]
- Driver incapacitation [Control ID: 7, 21, 25]
- Vehicle attachment not stowed [Control ID: 2, 3, 6, 8, 5, 23, 9, 10]

Systems (organisational factors)

- Poor / non existent communications (radio protocols) [Control ID: 8, 17, 18, 3, 5]
- poor possession management / level of knowledge [Control ID: 3, 8, 20, 17, 25, 18]
- Time pressures / work patterns [Control ID: 8, 20, 21, 25, 3]
- Moving in convoy [Control ID: 1, 3, 6, 5, 10, 8, 9, 17, 12, 14, 25, 24, 18, 7]

Collision control slide (off rail)

Non-emergency

Technical (technical failures) [Control ID: 7, 8]

- Equipment failure
- No brakes
- Design modification
- Inadequate design

Environment (local conditions) [Control ID: 1, 3]

- Accident by road vehicle at level crossing
- Contamination on rail
- Gradient
- Sun glare

People (individual / team actions)

- Travelling in convoy (poor communication protocol) [Control ID: 6, 7]
- Not sticking to plan [Control ID: 6, 7]
- Not competent on type of equipment [Control ID: 5]
- Not questioning authority if in doubt (safety culture) [Control ID: 3]
- Violations [Control ID: 1, 3, 5, 6, 7]
- Fitness for duty – fatigue, D&A, incapacitation

Systems (organisational factors)

- Inadequate training processes [Control ID: 4, 5, 7, 8]
- Inadequate procedures [Control ID: 9, 10]
- Inadequate standards [Control ID: 9, 10]
- Production demands [Control ID: 6, 7, 8, 9, 10]
- Inadequate resourcing [Control ID: 5, 11]
- Not competent on type of equipment [Control ID: 4, 5, 7, 8]
- Inadequate change management [Control ID: 3, 7, 6]

Emergency

Technical (technical failures) [Control ID: 6, 8]

- Unable to move machine
- No brakes
- Design modification
- Inadequate design

Environment (local conditions) [Control ID:1, 4, 6, 2]

- Off rail at non specified location / inappropriate location
- contamination
- Gradient
- visibility
- Terrain / infrastructure problem
- Washaway
- Bushfires / snow

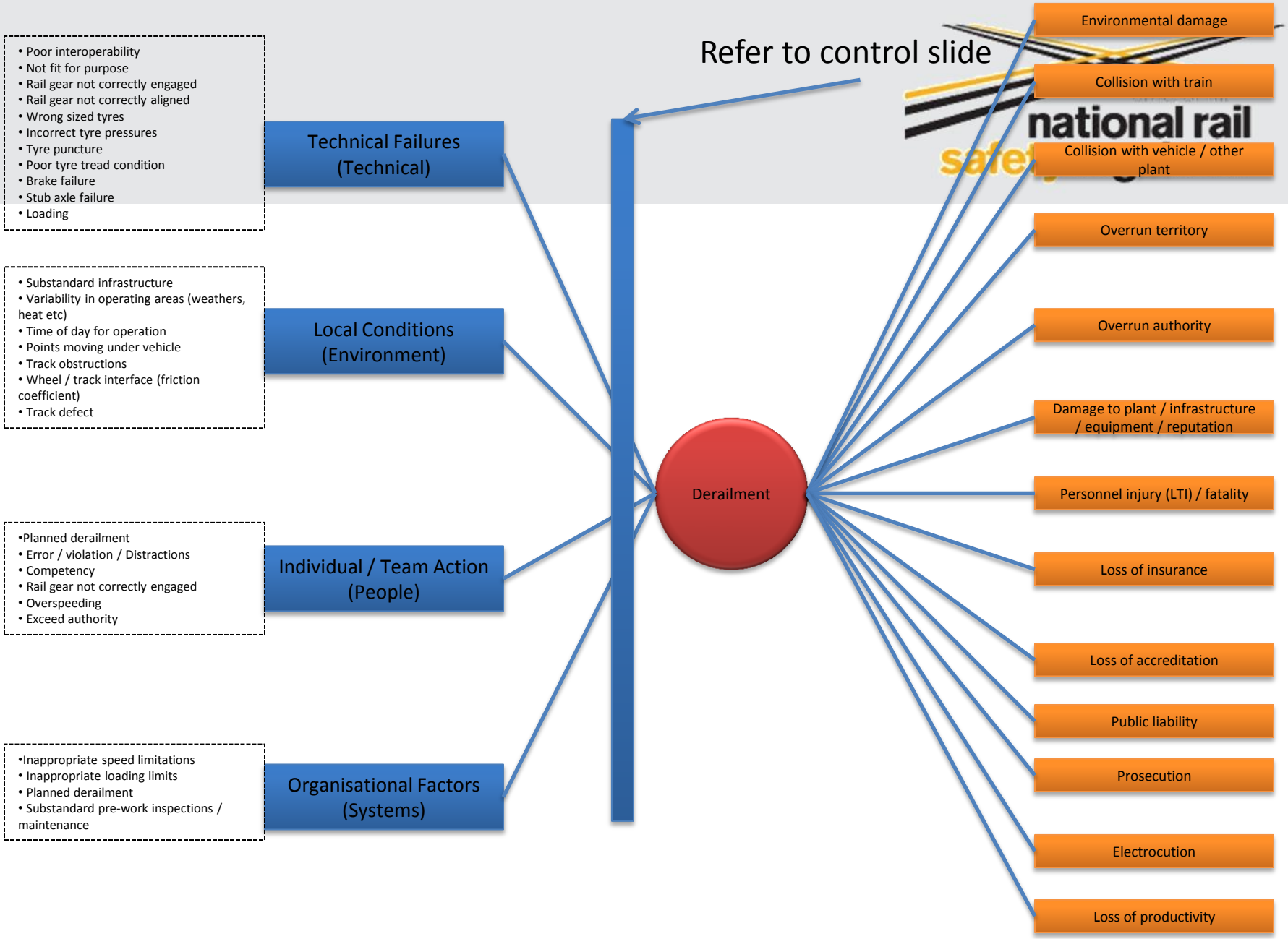
People (individual / team actions) [Control ID: 1, 2, 3, 4, 5, 6, 7, 8, 9]

- Competency
- Violation
- Lack of skills in emergency situation
- Communication error

Systems (organisational factors)

- Safe work component [Control ID: 1, 2]
- Inadequate consideration of all aspects of an “emergency” [Control ID: 1, 2, 3, 4]
- production demands [Control ID: 1, 2, 7]
- Inadequate training procedures [Control ID: 3, 6]
- Inadequate resourcing [Control ID: 9, 6]
- Inadequate procedure [Control ID: 10]

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Derailment	Technical (technical failures) • Poor interoperability (machine, network, operator) [Control ID: 26, 1, 3, 20, 5, 6, 13, 7, 8, 9, 10, 11, 12, 16, 17, 22] • Not fit for purpose [Control ID: 1, 2, 3, 5, 4, 6, 8, 12, 13, 20, 23, 26] • Rail gear not correctly engaged [Control ID: 2, 3, 5, 8, 12, 23] • Rail gear not correctly aligned [Control ID: same as above] • Wrong sized tyres[Control ID: 1, 2, 3, 5, 8, 12, 23, 19] • Incorrect tyre pressures [Control ID: same as above] • Tyre puncture [Control ID: 2, 5] • Poor tyre tread condition [Control ID: 2, 5] • Brake failure [Control ID: 2, 13, 1, 5, 4, 6] • Stub axle failure [Control ID: 5, 3, 12, 13, 25, 23, 4] • Loading [Control ID: 1, 2, 3, 4, 6, 8, 12, 13, 20, 25] Environment (local conditions) • Substandard infrastructure [Control ID: 1, 2, 3, 6, 8, 13, 25] • Variability in operating areas (weathers, heat etc) [Control ID: 1, 3, 6, 8, 24] • Time of day for operation [Control ID: 6] • Points moving under vehicle [Control ID: 1, 3, 6, 8, 17] • Track obstructions [Control ID: 6, 17, 24] • Wheel / track interface (friction coefficient) [Control ID: 5, 2, 3, 1, 6, 8, 12] • Track defect [Control ID: 6, 8, 17, 14] People (individual / team actions) • Planned derailment [Control ID: 9, 3, 17] • Error / violation / Distractions [Control ID: 3, 6, 10, 11, 8, 12, 17, 14, 21, 25] • Competency [Control ID: 1, 38, 12, 17, 25] • Rail gear not correctly engaged [Control ID: 2, 3, 5, 8, 12, 23] • Overspeeding [Control ID: 3, 6, 8, 14, 17, 25] • Exceed authority [Control ID: 3, 8, 9, 17, 25] Systems (organisational factors) • Inappropriate speed limitations [Control ID: 1, 8, 14, 6, 25, 17] • Inappropriate loading limits [Control ID: 1, 2, 4, 3, 8, 12, 25] • Planned derailment [Control ID: 9, 3, 17] • Substandard pre-work inspections / maintenance [Control ID: 1, 3, 8, 25]	•Environmental damage •Collision with train / vehicle / other plant / infrastructure / personnel •Derailment / rollover •SPAD •Overrun territory •Overrun authority •Damage to plant, equipment, infrastructure, reputation •Personnel injury (LTI) / fatality •Loss of insurance / accreditation •Public liability •Prosecution •Electrocution •Loss to productivity	1. OEM / RIM standards 2. Visual inspections 3. training 4. weight guides 5. vehicle maintenance 6. driving to conditions 7. vigilance system 8. rules & procedures 9. derailers, skids, speed limiters 10. D&A testing 11. Fatigue management 12. Pre-work inspections 13. braking systems 14. speed board (including TSR) 15. data logger 16. GPS tracking 17. Comms. Protocols 18. Train protection 19. Asset lifecycle management 20. Change management 21. Health standards 22. on/off track pads 23. interlocks 24. Weather monitoring 25. supervision 26. Ergonomics	


Refer to control slide
• Poor interoperability
• Not fit for purpose
• Rail gear not correctly engaged
• Rail gear not correctly aligned
• Wrong sized tyres
• Incorrect tyre pressures
• Tyre puncture
• Poor tyre tread condition
• Brake failure
• Stub axle failure
• Loading
Technical Failures (Technical)
• Substandard infrastructure
• Variability in operating areas (weathers, heat etc)
• Time of day for operation
• Points moving under vehicle
• Track obstructions
• Wheel / track interface (friction coefficient)
• Track defect
Local Conditions (Environment)
•Planned derailment
• Error / violation / Distractions
• Competency
• Rail gear not correctly engaged
• Overspeeding
• Exceed authority
Individual / Team Action (People)
•Inappropriate speed limitations
• Inappropriate loading limits
• Planned derailment
• Substandard pre-work inspections / maintenance
Organisational Factors (Systems)
Derailment
Environmental damage
Collision with train
Collision with vehicle / other plant
Overrun territory
Overrun authority
Damage to plant / infrastructure / equipment / reputation
Personnel injury (LTI) / fatality
Loss of insurance
Loss of accreditation
Public liability
Prosecution
Electrocution
Loss of productivity

Derailment control slide

Technical (technical failures)

- Poor interoperability (machine, network, operator) [Control ID: 26, 1, 3, 20, 5, 6, 13, 7, 8, 9, 10, 11, 12, 16, 17, 22]
- Not fit for purpose [Control ID: 1, 2, 3, 5, 4, 6, 8, 12, 13, 20, 23, 26]
- Rail gear not correctly engaged [Control ID: 2, 3, 5, 8, 12, 23]
- Rail gear not correctly aligned [Control ID: same as above]
- Wrong sized tyres[Control ID: 1, 2, 3, 5, 8, 12, 23, 19]
- Incorrect tyre pressures [Control ID: same as above]
- Tyre puncture [Control ID: 2, 5]
- Poor tyre tread condition [Control ID: 2, 5]
- Brake failure [Control ID: 2, 13, 1, 5, 4, 6]
- Stub axle failure [Control ID: 5, 3, 12, 13, 25, 23, 4]
- Loading [Control ID: 1, 2, 3, 4, 6, 8, 12, 13, 20, 25]

Environment (local conditions)

- Substandard infrastructure [Control ID: 1, 2, 3, 6, 8, 13, 25]
- Variability in operating areas (weathers, heat etc) [Control ID: 1, 3, 6, 8, 24]
- Time of day for operation [Control ID: 6]
- Points moving under vehicle [Control ID: 1, 3, 6, 8, 17]
- Track obstructions [Control ID: 6, 17, 24]
- Wheel / track interface (friction coefficient) [Control ID: 5, 2, 3, 1, 6, 8, 12]

• Track defect [Control ID: 6, 8, 17, 14]

People (individual / team actions)

- Planned derailment [Control ID: 9, 3, 17]
- Error / violation / Distractions [Control ID: 3, 6, 10, 11, 8, 12, 17, 14, 21, 25]
- Competency [Control ID: 1, 38, 12, 17, 25]

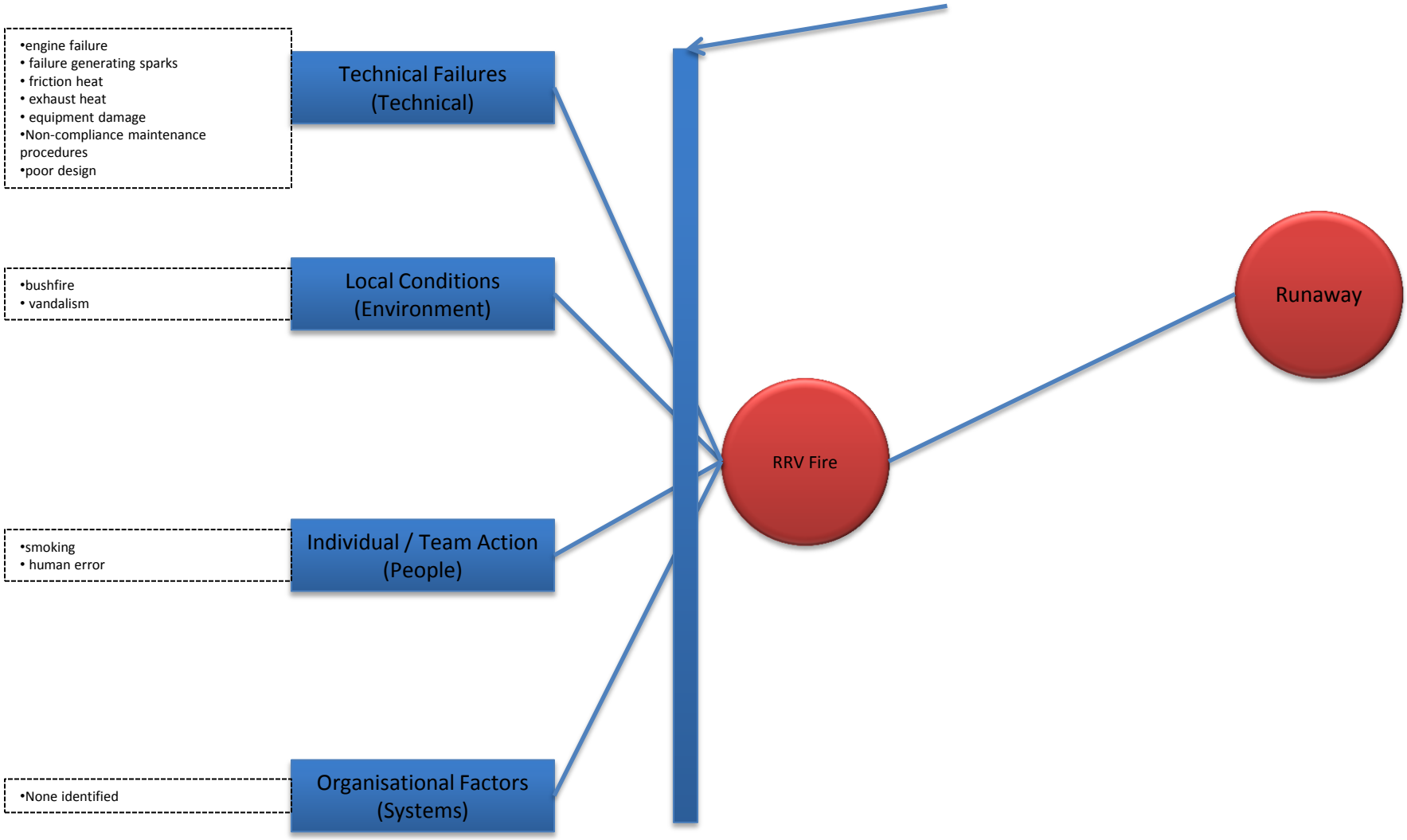
• Rail gear not correctly engaged [Control ID: 2, 3, 5, 8, 12, 23]
• Overspeeding [Control ID: 3, 6, 8, 14, 17, 25]
• Exceed authority [Control ID: 3, 8, 9, 17, 25]

Systems (organisational factors)

- Inappropriate speed limitations [Control ID: 1, 8, 14, 6, 25, 17]
- Inappropriate loading limits [Control ID: 1, 2, 4, 3, 8, 12, 25]
- Planned derailment [Control ID: 9, 3, 17]
- Substandard pre-work inspections / maintenance [Control ID: 1, 3, 8, 25]

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Fire	Technical (technical failures) • engine failure [Control ID: 1, 2, 3, 5, 6, 7, 8, 9, 10] • failure generating sparks [Control ID: 1, 2, 3, 6, 7, 8, 9] • friction heat [Control ID: 1, 2, 3, 6, 7, 8] • exhaust heat [Control ID: 1, 2, 3, 6, 7, 8] • equipment damage [Control ID: refer to engine failure] •Non-compliance maintenance procedures [Control ID: 1, 4, 6, 7, 9, 10] • poor design [Control ID: 3] Environment (local conditions) • bushfire [Control ID: 1, 9, 10, 7, 6, 4] • vandalism [Control ID: 6, 7, 9, 10, 4, 1, 7] People (individual / team actions) • smoking [Control ID: 1, 4, 6, 9, 10] • human error [Control ID: as above] Systems (organisational factors) [Control ID: 1, 6, 9, 10]	Runaway	1. Extinguishers 2. spark suppression (some) 3. design standards 4. Rules & procedures 5. Dust suppression (some) 6. Maintenance procedures / SOPs 7. Pre-work inspections 8. System checks 9. People management / training / culture 10. Supervision	

Refer to control slide



Fire control slide

Technical (technical failures)

- engine failure [Control ID: 1, 2, 3, 5, 6, 7, 8, 9, 10]
- failure generating sparks [Control ID: 1, 2, 3, 6, 7, 8, 9]
- friction heat [Control ID: 1, 2, 3, 6, 7, 8]
- exhaust heat [Control ID: 1, 2, 3, 6, 7, 8]
- equipment damage [Control ID: refer to engine failure]
- Non-compliance maintenance procedures [Control ID: 1, 4, 6, 7, 9, 10]
- poor design [Control ID: 3]

Environment (local conditions)

- bushfire [Control ID: 1, 9, 10, 7, 6, 4]
- vandalism [Control ID: 6, 7, 9, 10, 4, 1, 7]

People (individual / team actions)

- smoking [Control ID: 1, 4, 6, 9, 10]
- human error [Control ID: as above]

Systems (organisational factors) [Control ID: 1, 6, 9, 10]

PROPOSED CONTROLS

FOLLOW UP ACTIONS

Proposed controls

- **Separation alarm systems**
- **All trailers brake system fitted**
- **Clarification of where vigilance control systems are required**
- **Clarify design consistency needs (RIM/OEM, engineering issues)**
- **Proximity sensors**
- **Audible alarms (loss of traction (better alarms automated))**
- **Coupling rules (physical connections rules in context with equipment)**
- **Emergency response (expanded scenarios)**

- Standards
  - Applicability of current rolling stock standards
  - Proliferation of requirements (eg multiple RIMS etc)
  - Differing terminology /classification systems (UK/ local)
  - Potential for specific RRV national standard ?
  - Capture existing good work (LOR, JHR, V-line etc)

- Data
  - No national approach to incident data collection
  - Ability to trend data
  - RISSB building capacity for data collection/analysis
  - Will strengthen risk basis of RISSB standards

Issues

- Competence and culture
  - National approach, and
  - Vehicle specific training
  - Gangers vs head office
  - Low literacy may be an issue

Issues

- Risk management
  - Accidents/incidents occurring despite controls
  - Control effectiveness??

- Road authority vs. rail compatibility
  - Expense of crash testing

Lindsay Holt – Laing O'Rourke

NETWORK STANDARDS

(SEE SEPARATE PRESENTATION)

Rae Fossard - TLISC

WORKFORCE CAPABILITY

(SEE SEPARATE PRESENTATION)

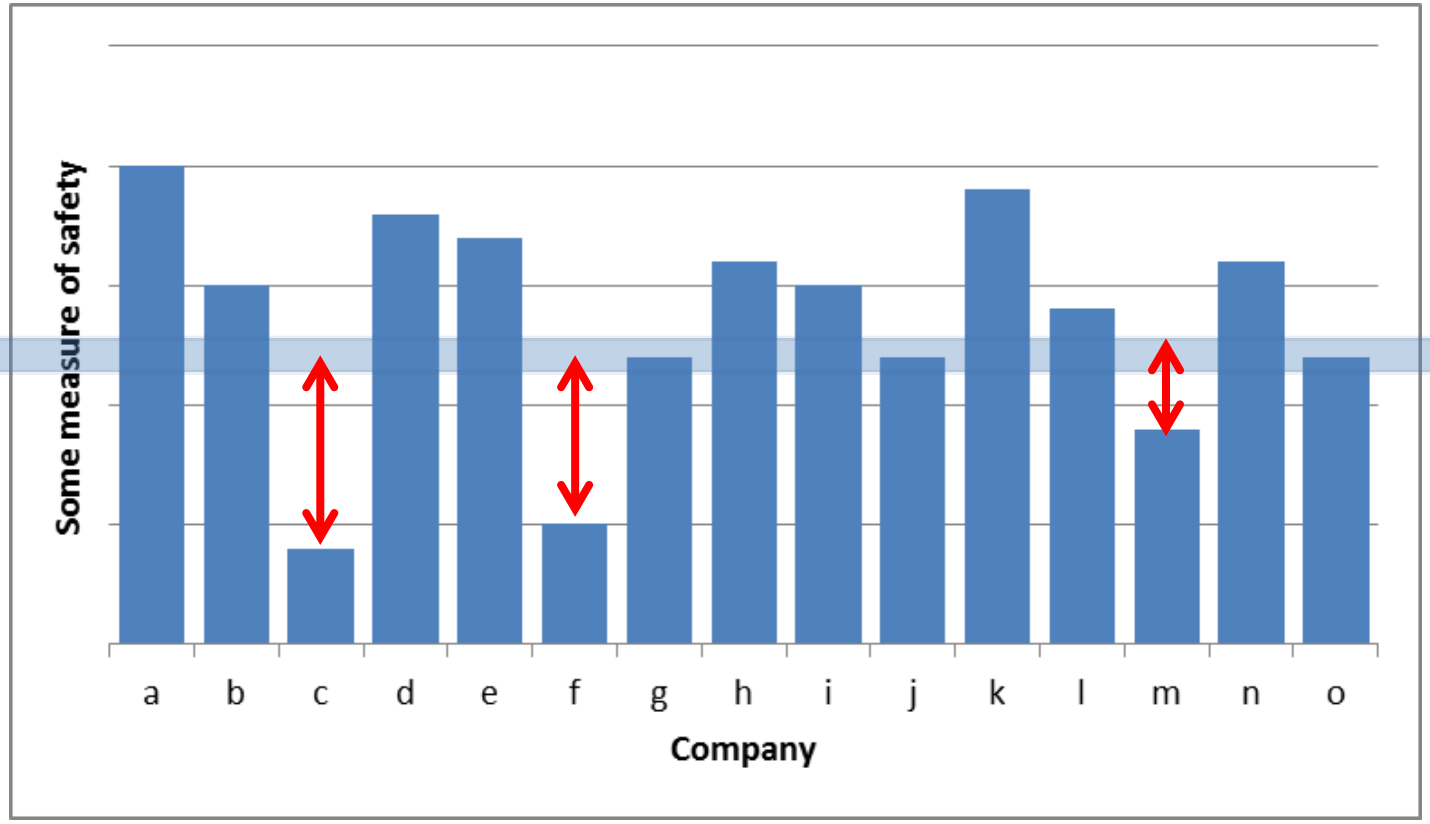
Adrian Rowland - ONRSR

CERTIFICATION AND REGISTRATION ISSUES

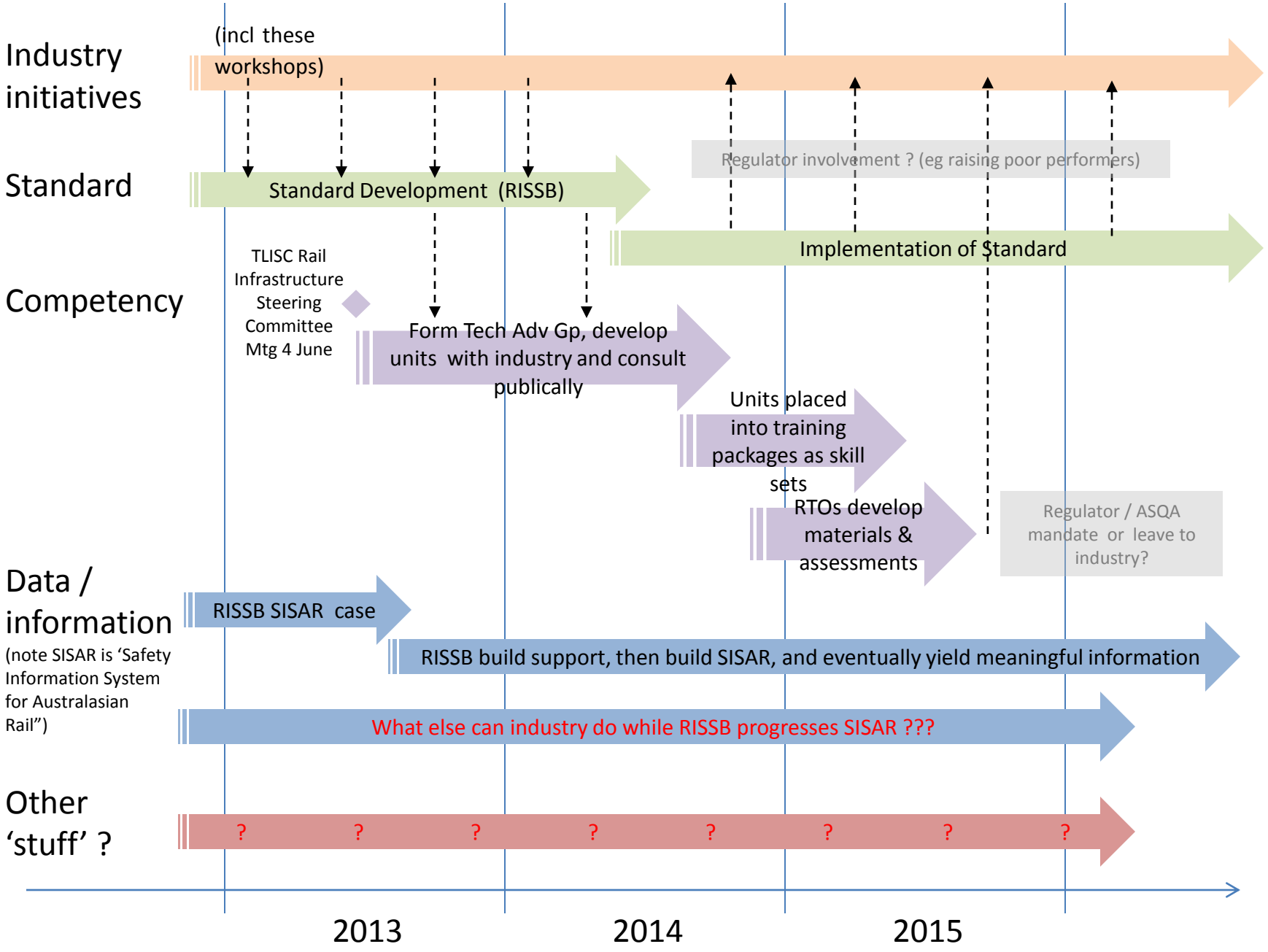
Focus on safety

- New National Rail Safety Law
  - Imposes the duty to achieve the best possible safety outcome ‘so far as is reasonably practicable’
- New Office of the National Rail Safety Regulator
  - Very supportive of RISSB
  - Working with RISSB to advance safety agenda
  - Safety plans

Safety plans



Industry good practice


Industry initiatives
(incl these workshops)
Standard
Standard Development (RISSB)
Regulator involvement ? (eg raising poor performers)
Implementation of Standard
Competency
TLISC Rail Infrastructure Steering Committee Mtg 4 June
Form Tech Adv Gp, develop units with industry and consult publically
Units placed into training packages as skill sets
RTOs develop materials & assessments
Regulator / ASQA mandate or leave to industry?
Data / information
(note SISAR is 'Safety Information System for Australasian Rail")
RISSB SISAR case
RISSB build support, then build SISAR, and eventually yield meaningful information
What else can industry do while RISSB progresses SISAR ???
Other 'stuff' ?
? ? ? ? ? ? ? ?
2013
2014
2015

Jesse Baker, Alex Borodin, Adrian Rowland

FUTURE ACTIONS DISCUSSION

- More workshops (Sydney/Adelaide)
- Consolidation of results and information
- Web based summary of findings and actions (RISSB & ONRSR)
- Standards development group (July)
- Research bulletin (ONRSR)