

RRV Safety Improvement

Adelaide, 14 October 2013

RRV safety improvement

With a history of poor safety performance, coupled with intelligence gathered from industry, the ONRSR is concerned that these risks remain an ongoing threat and action is needed to improve safety

Haig – Western Australia



Perth, City Link – Western Australia



Rinadeena - Tasmania



Purpose of workshops

- Build on **industry knowledge** sharing from earlier RRV workshops
- Highlight **known significant** RRV risk factors
- Suggest **tools and approaches** operators may consider in the assessment and management of RRV risks for their own situations
- **Update industry** on the development of the RISSB RRV standard
- Outline **ONRSR's expectations** in terms of RRV safety improvement actions by operators.

ONRSR overview

National Focus on the RRV issues by ONRSR

- Overview of Approach
- Co- Regulatory Approach
- Evaluate and promote safety
- Inform industry of risks and actions required
- Check for compliance: eg, effective risk controls
- Enforce where required - graduated enforcement approach

ONRSR overview

- Rail Safety National Law 2012 (in SA)
- ONRSR (in Adelaide)
- Central Branch Structure
- Regulatory Interface with Industry

**Questions on the new
arrangements in Central Branch?**

ONRSR approach to RRV safety

- Inform Industry of the issues:
 - National and strategic RRV issues (long term)
 - Accredited operator issues (here and now)
 - Inform industry of risks and actions expected
 - Workshops
 - Safety Bulletin
 - Tools (Bow Ties) on website
 - Accredited Operators and the contractors they employ

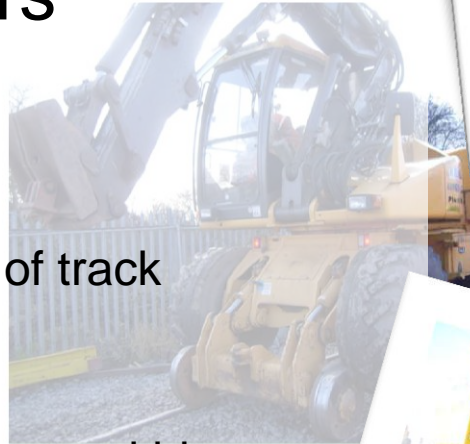
ONRSR approach to RRV safety

- Check for compliance e.g. –
 - have risks been re-assessed?
 - are effective risk controls in place?
- Enforce where required
 - ONRSR Compliance and Enforcement Policy
 - Proportionate response

Test at the end 😊

RRV types, use & operating modes

- Types: A/B/C & trailers
- Use
 - Running between worksites
 - Maintenance and inspection of track
- Operating modes
 - Possession (authority to operate within worksite)
 - Possession (running between worksites)
 - Possession (track maintenance and inspection)
 - Railing / off railing
 - Stowage on rail



Work to date

Non-technical issues identified

Standards

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

MANUFACTURED BY	ARROW FORKLIFT SERVICES P/L
	0415 648 332
	Made in Australia
MANUFACTURER'S NAME:	Arrow Forklift
YEAR OF MANUFACTURE:	Services Pty. Ltd.
SERIAL NO.:	2009
DESIGN REGISTRATION NO.:	X 5.2 / 006
RATED CAPACITY:	HST 6-93566/07
	750 kg or 5 Persons
	+ 350 kg
RATED CAPACITY OF TRAVERSING PLATFORM:	250 kg
MAX. ALLOWABLE MANUAL FORCE:	40 kg
MAX. ALLOWABLE WIND SPEED:	12.5 m/sec
STABILITY:	5 Degrees
MAX. PERMITTED CHASSIS INCLINATION:	5 Degrees
ELEVATING WORK PLATFORM MASS:	4500 kg
MAX. SPEED OF ELEVATING WORK	5 kph
PLATFORM IN FULLY EXTENDED POSITION	

Items considered for inclusion in registration process

- Registration
- Twist Test
- Brake Test
- Rolling Stock Outline
- Electrical
- Ride Stability Test
- Flashing Light: linked
- Reversing Beeper
- Reversing Camera
- Insulated Wheels
- Super Singles
- Twin Tyred
- ROP's / FOP's
- Vigilance Control
- Event Recorder
- Distance Recorder
- Engineer's Report
- Re – Registration
- Interlocking Systems
- Visual Displays
- Operator Control Device
- Audible Warning Device
- Height / Slew / Reach Indicator
- Hi-Rail Guidance Compliance Plates
- Vertical Load
- Safe Working Load
- Parking Brake Capability
- Speed Indicator Device
- EWP's Compliant to AS 2550
- Axle Load Compliant
- EPA Noise and Vibration Control

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Registration – the current criteria

Many variations between rail infrastructure managers

[illegible]

Work to date

- 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

Work to date

- Risk management
 - Accidents/incidents occurring despite controls
 - Control effectiveness??
- Road authority vs. rail compatibility
 - Expense of crash testing
- Competence and culture
 - National approach to be revised, and
 - Vehicle specific training
 - Difference between Gangs and Head office
 - Low literacy can be an issue

Work to date

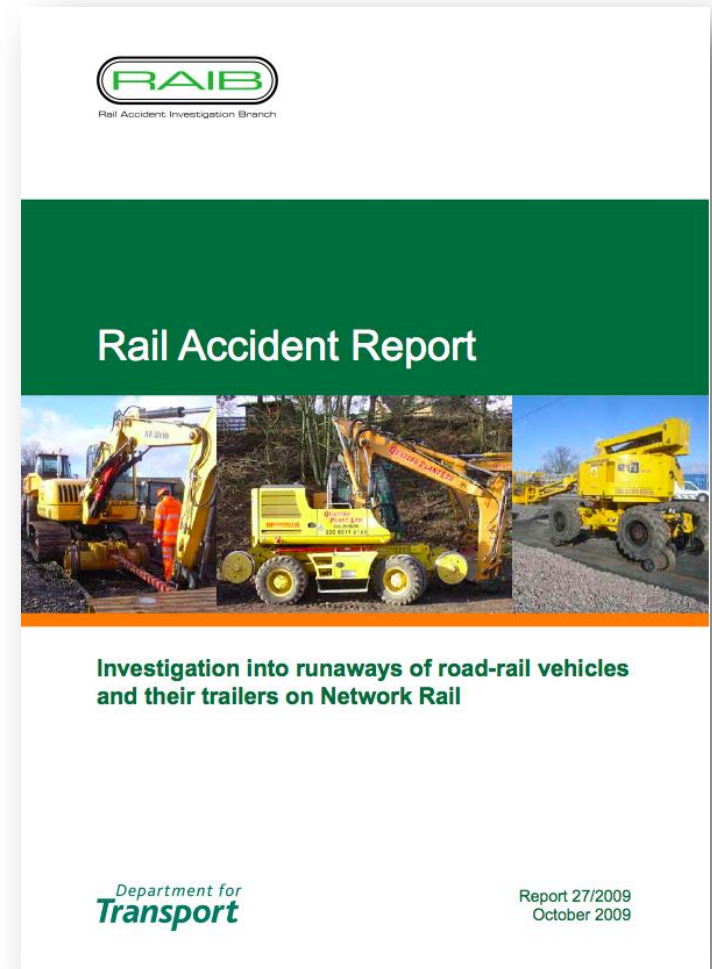
Technical issues identified

- Fitment and use of ancillary fail-safe braking systems
- Familiarity and understanding of braking systems
- Unplanned or unprepared on/off tracking
- Use of temporary buffer stops around high risk RRV operations



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



Background information on hi rails

- 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 as 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 (eg, gradient and rail contamination), travelling at excessive speed, as well as a combination of both.

CFF of RAIB report – individual & 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 taken into account in 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.

Work to date: ONRSR safety bulletin

Safety Bulletin

Managing the risks associated with road/rail vehicles

No. 1 – August 2013

Safety Bulletins identify areas of concern, share information and identify positive steps to enhance safety

The Office of the National Rail Safety Regulator (ONRSR) has been working closely with the rail industry to assist in the identification and management of risks associated with the operation of Road/Rail Vehicles (RRVs).

With a history of poor safety performance, coupled with intelligence gathered from industry, the ONRSR is concerned that these risks remain an ongoing threat and action is needed to improve safety.

In this, the first Safety Bulletin published by the ONRSR, the background to the risks associated with RRV operation and the work undertaken to date by the ONRSR in conjunction with industry is explored.

The ONRSR remains committed to working with industry to help manage these risks and this bulletin outlines the regulator's future intentions in assisting industry to improve the safety of RRV operations.

Safety performance

There has been a significant number of RRV occurrences in recent years, some with fatal consequences.

Recent incidents include:

- 4 June 2013 – Rinadeena Tasmania, RRV collision, serious injury and multiple minor injuries
- 24 May 2012 – Hail Western Australia, track worker struck and killed by RRV
- 30 December 2011 – Perth Western Australia, track worker struck and killed by RRV.

Based on the known historic data, supported by intelligence gathered from industry, the ONRSR is concerned that the risk associated with the operation of these vehicles remains unacceptably high and that action is needed to improve safety performance.

The issues surrounding RRV safety are complicated by the large range of RRV types, the range of incidents experienced and the many sources of risk that require effective management.

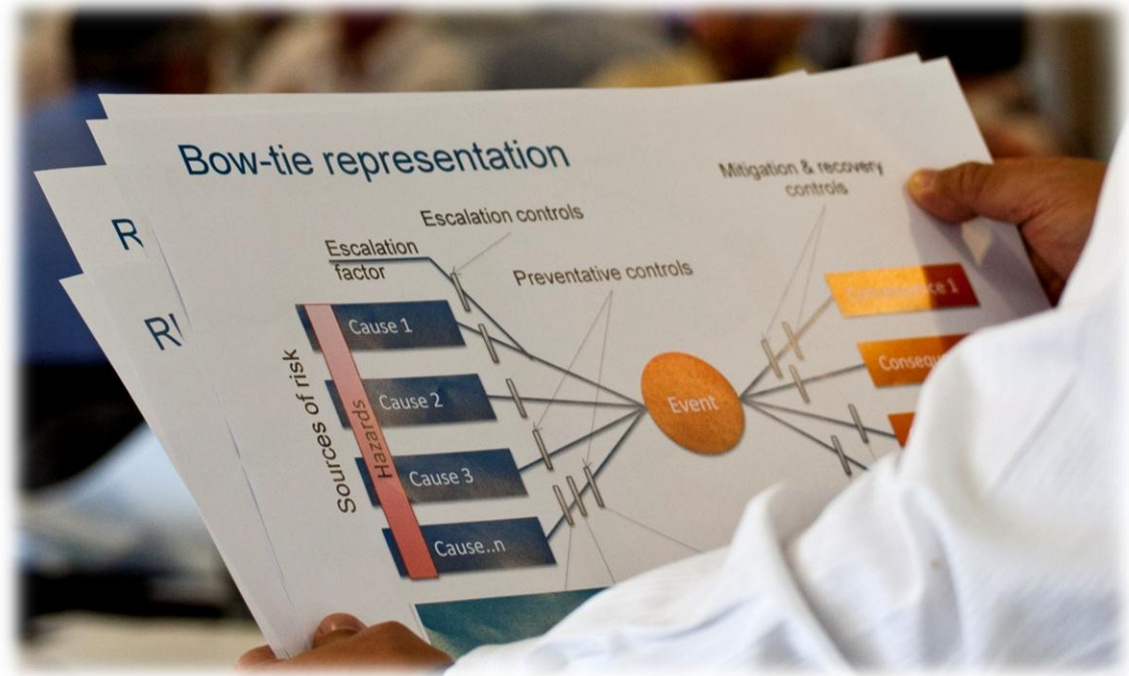
For further information:
Call: 08 8406 1500
Email: contact@onrsr.com.au
Visit: www.onrsr.com.au



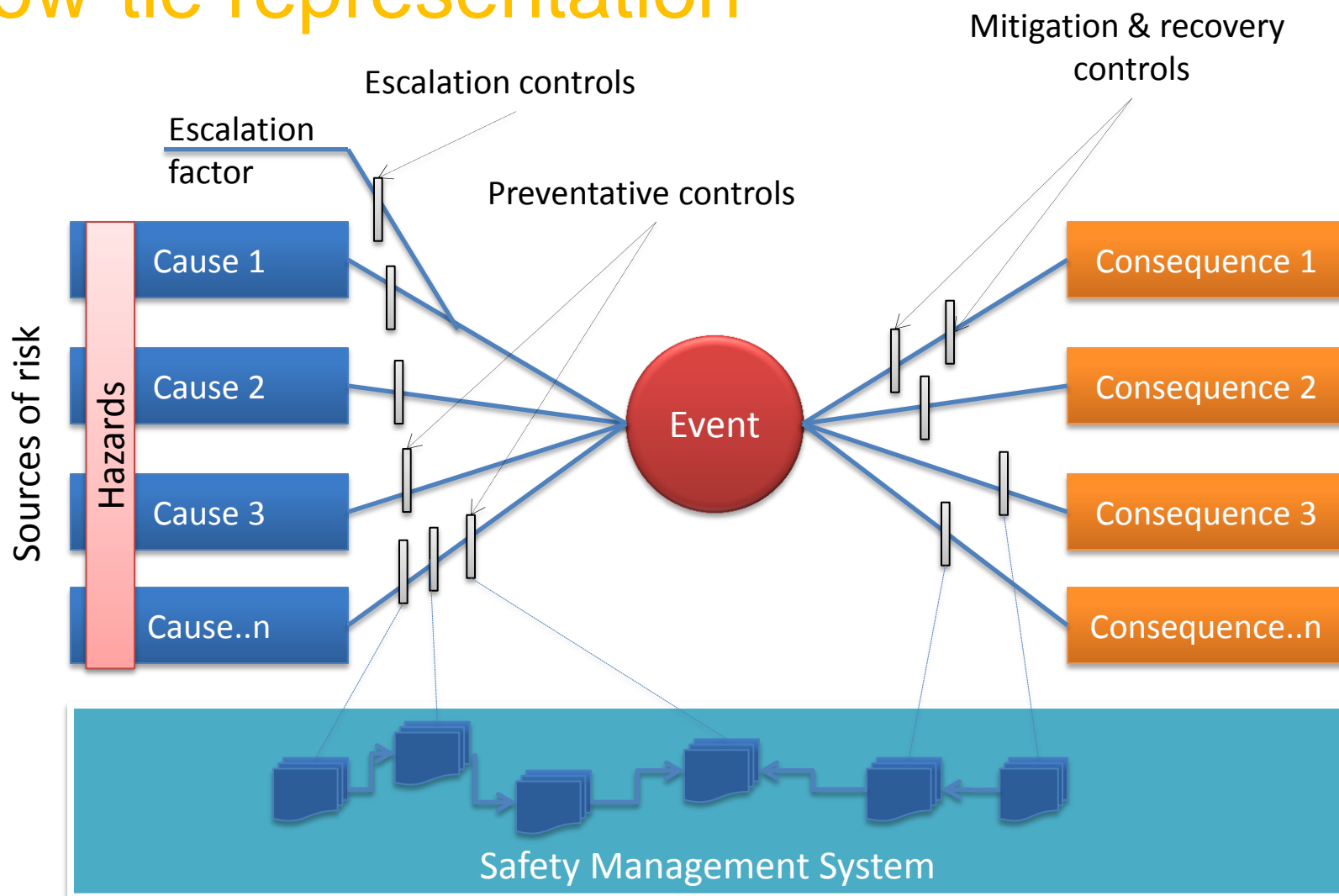
Work to date: PHA results & bow ties

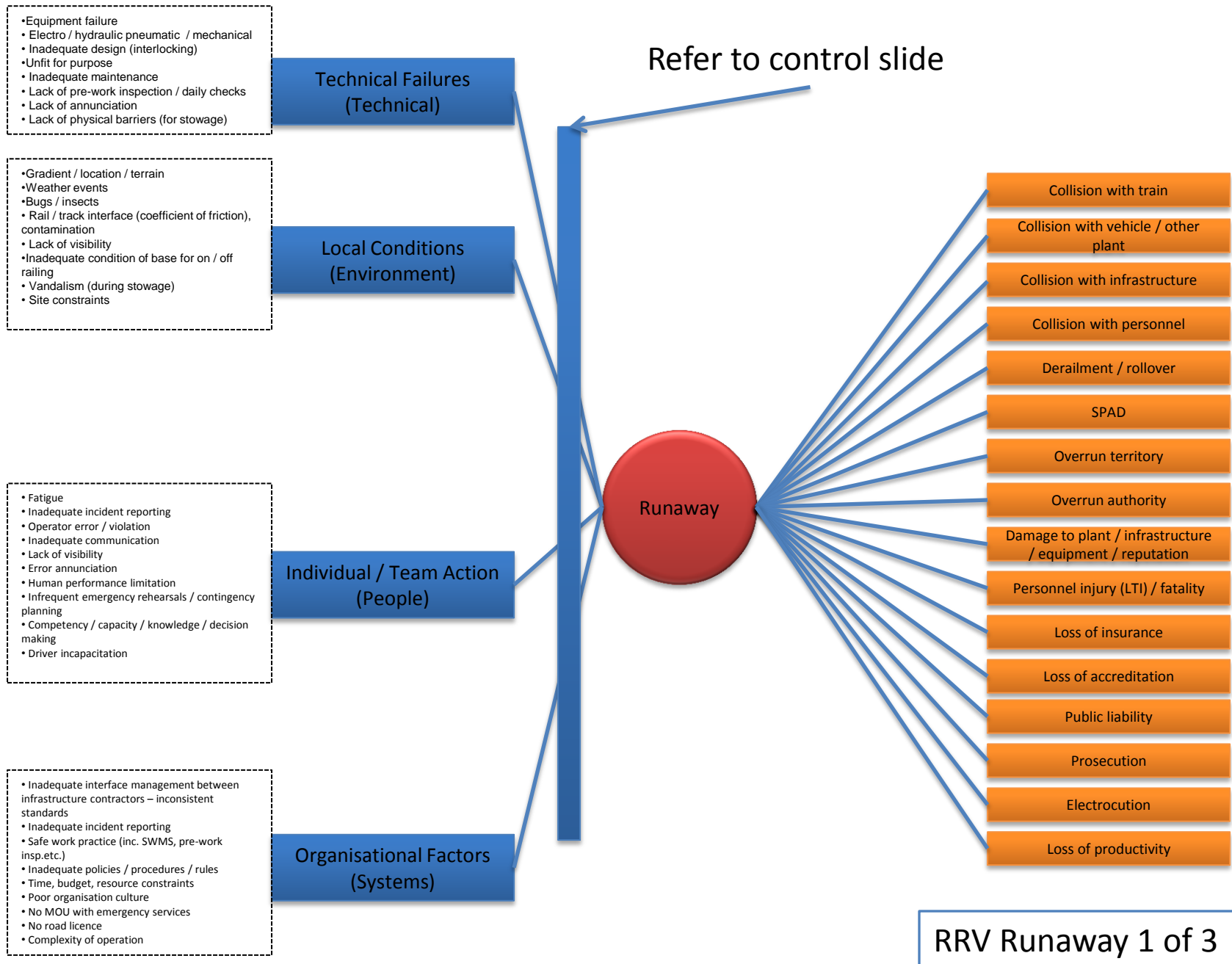
Top Events

- Runaway
- Collision
 - On/Off Railing
- Derailment
- RRV Fire



Bow-tie representation





Runaway control

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)

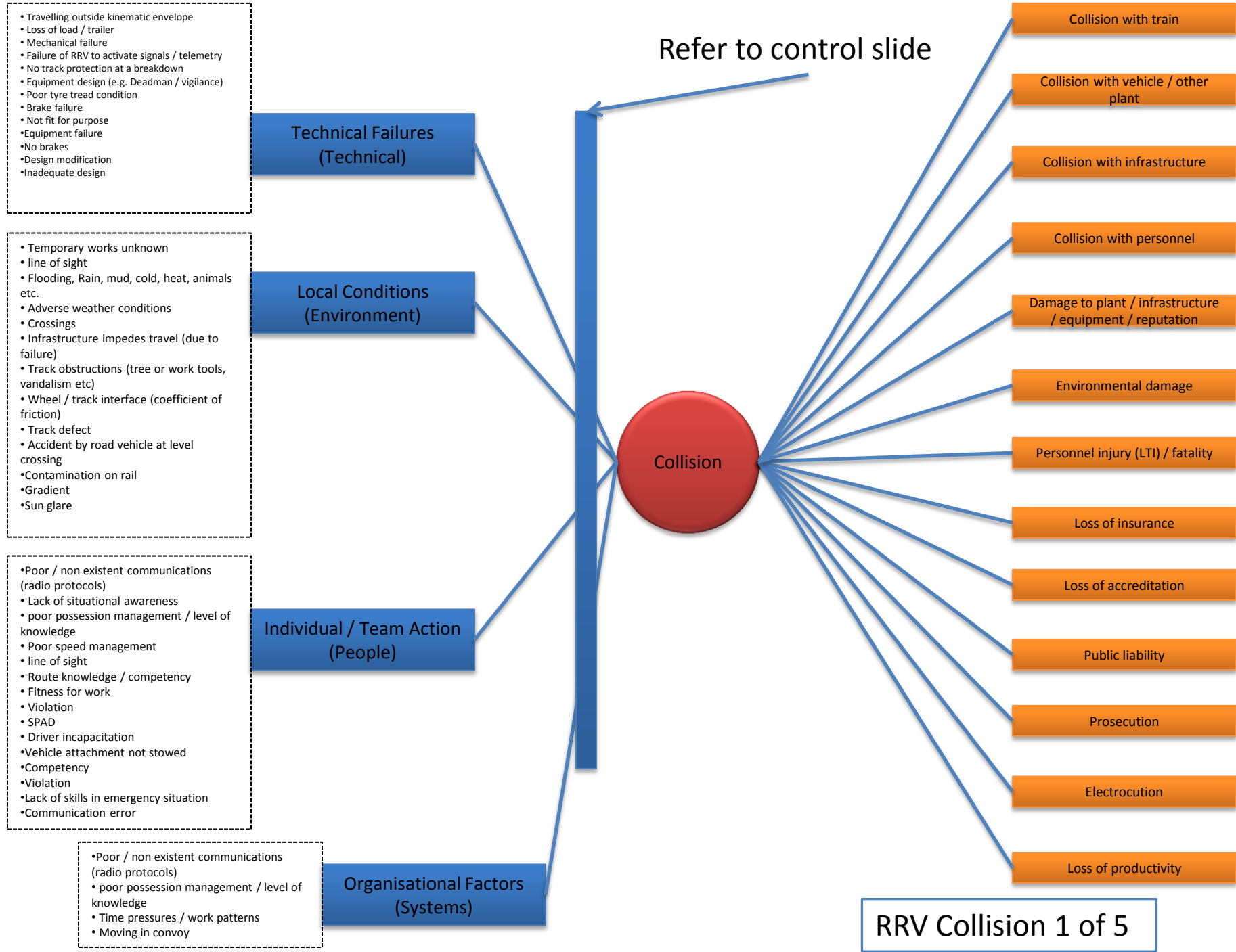
- Fatigue [Control ID: 1, 8, 10, 13, 15, 34, 38]
- Inadequate incident reporting [Control ID: 1, 5, 9, 10, 11, 13, 14, 18, 33, 38]
- Operator error / violation [Control ID: 1, 5, 6, 8, 9, 10, 13, 15, 16, 17, 18, 20, 21, 25, 26, 27, 30, 33, 35, 36, 37]
- Inadequate communication [Control ID: 1, 5, 6, 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]

RRV Runaway 2 of 3

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Runaway	<p><u>Technical (technical failures)</u></p> <ul style="list-style-type: none"> Equipment failure [Control ID: 1, 2, 3, 5, 6, 7, 8, 12, 14, 20, 22, 23, 24, 25, 26, 32, 33, 35, 36, 38] <ul style="list-style-type: none"> 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] <p><u>Environment (local conditions)</u></p> <ul style="list-style-type: none"> 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] <p><u>People (individual / team actions)</u></p> <ul style="list-style-type: none"> 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] <p><u>Systems (organisational factors)</u></p> <ul style="list-style-type: none"> 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] 	<ul style="list-style-type: none"> 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 	<ol style="list-style-type: none"> SOPs / JSAs / SWMS / Management standards Technical and performance specifications Design input Accreditation of organisation / equipment Technical registration / certification / training System checks – sampling of procedural controls Long-term monitoring Fatigue, D&A management program Maintenance / inspection schedules & plans Inductions Industry / regulator interactions / alerts Procurement processes People management – discipline arrangements / training / culture Interface management Possession management / coordination / network registration Network rules Route competency Workplace inspections / management Secondary / alternate comms. Derailers / level crossing infrastructure Catch points / derailleurs Site security (for stowage) Chocks for stowage (for stowage) Stow vehicle off-track derailers, skids, speed limiters braking systems speed board data logger GPS tracking Comms. Protocols Train protection Asset lifecycle management Change management Health standards on/off track pads interlocks Weather monitoring supervision Rail safety investigations Driver safety systems 	
RRV Runaway 3 of 3				



Collision control (off rail)

RRV Runaway 2 of 3

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 (off rail)

RRV Collision 2 of 5

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]

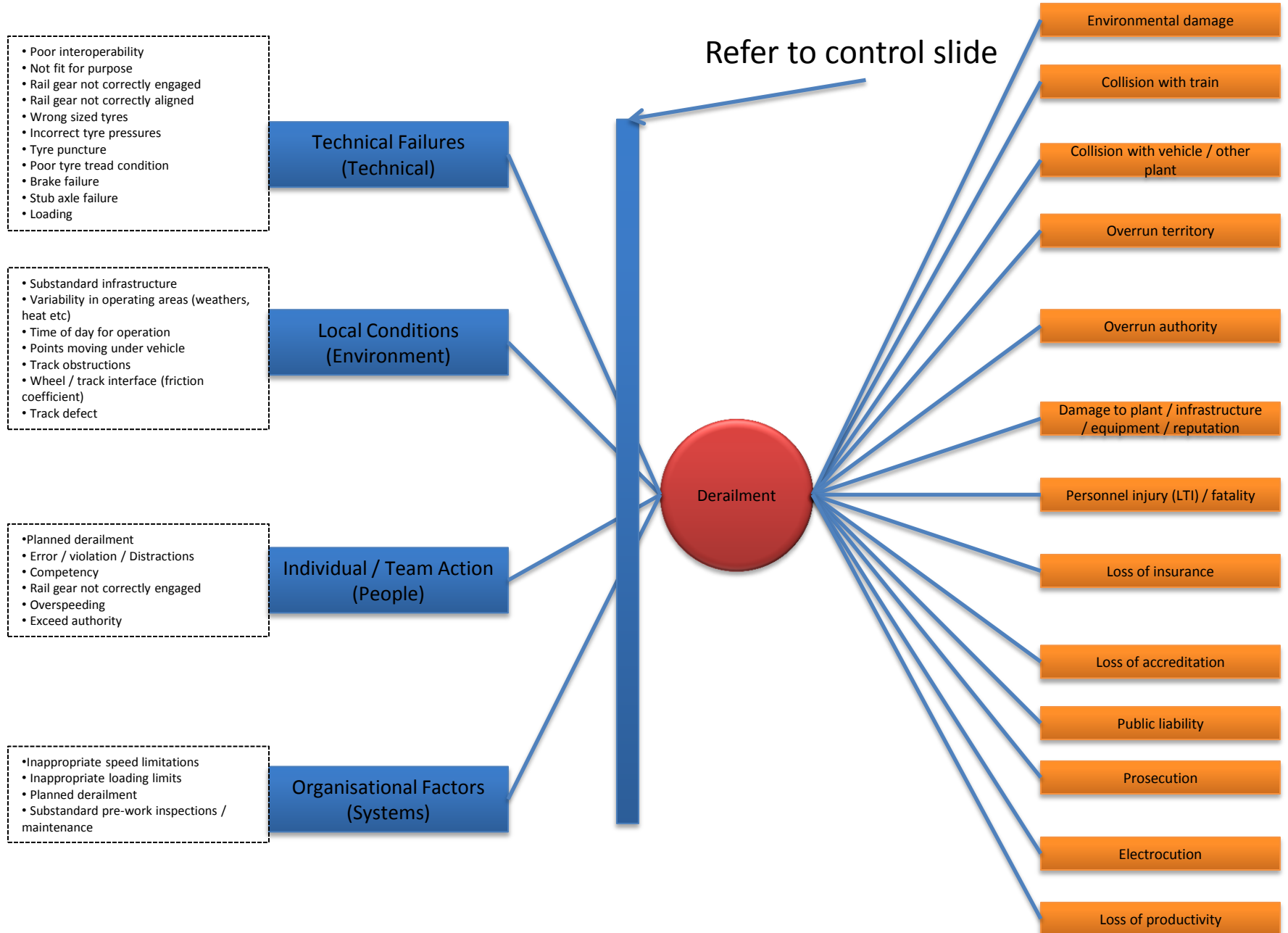
- Competency
- Violation
- Lack of skills in emergency situation
- Communication error

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 Collision	<p><u>Technical (technical failures)</u></p> <ul style="list-style-type: none"> • 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] <p><u>Environment (local conditions)</u></p> <ul style="list-style-type: none"> • 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] <p><u>People (individual / team actions)</u></p> <ul style="list-style-type: none"> • 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] <p><u>Systems (organisational factors)</u></p> <ul style="list-style-type: none"> • 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] 	<ul style="list-style-type: none"> •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 	<ol style="list-style-type: none"> 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 	<p>Separation alarm systems</p> <p>All trailers brake system fitted</p> <p>Clarification of where vigilance control systems are required</p> <p>Clarify design consistency needs (RIM/OEM, engineering issues)</p> <p>Proximity sensors</p> <p>Audible alarms (loss of traction (better alarms automated))</p> <p>Coupling rules (physical connections rules in context with equipment)</p> <p>Emergency response (expanded scenarios)</p>

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Collision (specific to off rail)	<p><u>Technical (technical failures)</u> [Control ID: 7, 8]</p> <ul style="list-style-type: none"> •Equipment failure •No brakes •Design modification •Inadequate design <p><u>Environment (local conditions)</u> [Control ID: 1, 3]</p> <ul style="list-style-type: none"> • Accident by road vehicle at level crossing •Contamination on rail •Gradient •Sun glare <p><u>People (individual / team actions)</u></p> <ul style="list-style-type: none"> • 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 <p><u>Systems (organisational factors)</u></p> <ul style="list-style-type: none"> •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] 	<ul style="list-style-type: none"> •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 	<ol style="list-style-type: none"> 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)	<p><u>Technical (technical failures)</u> [Control ID: 6, 8]</p> <ul style="list-style-type: none"> • Unable to move machine •No brakes •Design modification •Inadequate design <p><u>Environment (local conditions)</u> [Control ID:1, 4, 6, 2]</p> <ul style="list-style-type: none"> • Off rail at non specified location / inappropriate location • contamination •Gradient •visibility • Terrain / infrastructure problem • Washaway • Bushfires / snow <p><u>People (individual / team actions)</u> [Control ID: 1, 2, 3, 4, 5, 6, 7, 8, 9]</p> <ul style="list-style-type: none"> •Competency •Violation •Lack of skills in emergency situation •Communication error <p><u>Systems (organisational factors)</u></p> <ul style="list-style-type: none"> • 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] 	<ul style="list-style-type: none"> •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 	<ol style="list-style-type: none"> 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 	



Derailment control

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]

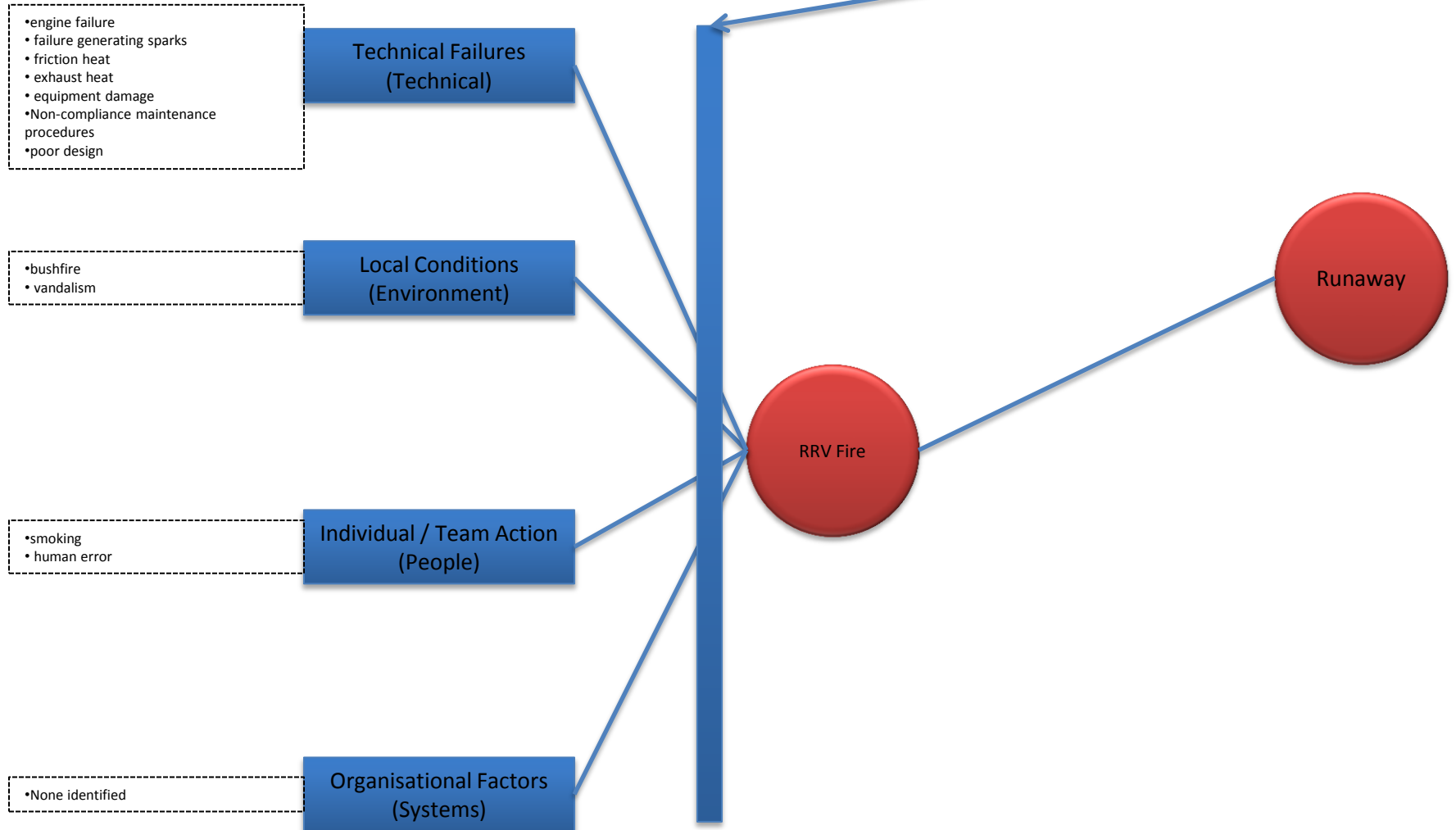
Systems (organisational factors)

- 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]

RRV Derailment 2 of 3

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Derailment	<p><u>Technical (technical failures)</u></p> <ul style="list-style-type: none"> • 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] <p><u>Environment (local conditions)</u></p> <ul style="list-style-type: none"> • 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] <p><u>People (individual / team actions)</u></p> <ul style="list-style-type: none"> • 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] <p><u>Systems (organisational factors)</u></p> <ul style="list-style-type: none"> • 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] 	<ul style="list-style-type: none"> • 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 	<ol style="list-style-type: none"> OEM / RIM standards Visual inspections training weight guides vehicle maintenance driving to conditions vigilance system rules & procedures derailers, skids, speed limiters D&A testing Fatigue management Pre-work inspections braking systems speed board (including TSR) data logger GPS tracking Comms. Protocols Train protection Asset lifecycle management Change management Health standards on/off track pads interlocks Weather monitoring supervision Ergonomics 	

Refer to control slide



Fire control

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]

RRV Fire 2 of 3

Hazardous event	Potential Cause(s)	Potential Consequence(s)	Existing control(s)	Proposed control(s)
RRV Fire	<p><u>Technical (technical failures)</u></p> <ul style="list-style-type: none"> • 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] <p><u>Environment (local conditions)</u></p> <ul style="list-style-type: none"> • bushfire [Control ID: 1, 9, 10, 7, 6, 4] • vandalism [Control ID: 6, 7, 9, 10, 4, 1, 7] <p><u>People (individual / team actions)</u></p> <ul style="list-style-type: none"> • smoking [Control ID: 1, 4, 6, 9, 10] • human error [Control ID: as above] <p><u>Systems (organisational factors)</u> [Control ID: 1, 6, 9, 10]</p>	Runaway	<ol style="list-style-type: none"> 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 	

Key issues for use of bow-ties

Consider:

- the RTO operating environment, including the scale and complexity of such operations
- the specific physical and operational characteristics of the RRVs that are operated
- the specific nature of operations of the RRVs, including where vehicles are placed on track, operated and taken off track
- the competencies of the personnel operating the equipment.
- Any controls identified through the RTO risk assessments should be integrated within operating procedures, training programs, competency assessments and assessed for effectiveness.
- Importantly, contractors that operate under an RTO's safety management system should be assessed by the RTO to ensure they also have effective controls in place.

Issues of concern

- Competency
- RIM Approaches
- Variety of Equipment
- Rolling Stock vs RRVs
- Standards
- Complacency

ONRSR expectations

- Inform Industry of the issues.
 - National and Strategic RRV Issues – (long term)
 - Accredited Operator Issues – (here and now)
 - Inform industry of risks and actions expected
 - Questionnaire.
- Check for compliance
 - have risks been re-assessed?
 - are effective risk controls in place?
- Enforce where required
 - ONRSR Compliance and Enforcement Policy
 - Proportionate response

ONRSR expectations

What will ONRSR be looking for in its questionnaire?

- Data collection to gather and share intelligence on RRV use,
- RRV types and number?
- What are your arrangements with contractors?
- How you collect incident data and what you do with it?
- What would you like improved on data collection?
- Training and competency for RRV's – who and what resources do you use?
- Internal audit processes – when was RRV safety last audited by your organisation?
- What additional hazards have you identified since the workshop?
- What controls did you implement as a result?
- What do you do well?

ONRSR expectations

Questionnaire timings

- 3 months post this workshop questionnaire will be sent out to organisations.
- 14 days to respond.
- You will need to take action before the questionnaire arrives!
- Focus of compliance activities based on questionnaire response
- No response means you will get a visit!
- De-identified information will be shared with RISSB and the RISSB standards development team.

ONRSR expectations: compliance

Not here to tell you how to fix it

- Demonstrate that your current risk register is adequately controlling the risks identified and supporting risk assessments remain valid.
 - Access to risk registers
 - Risk assessments
 - Reviews/internal audits
- Confirm identified controls are in place and effective.

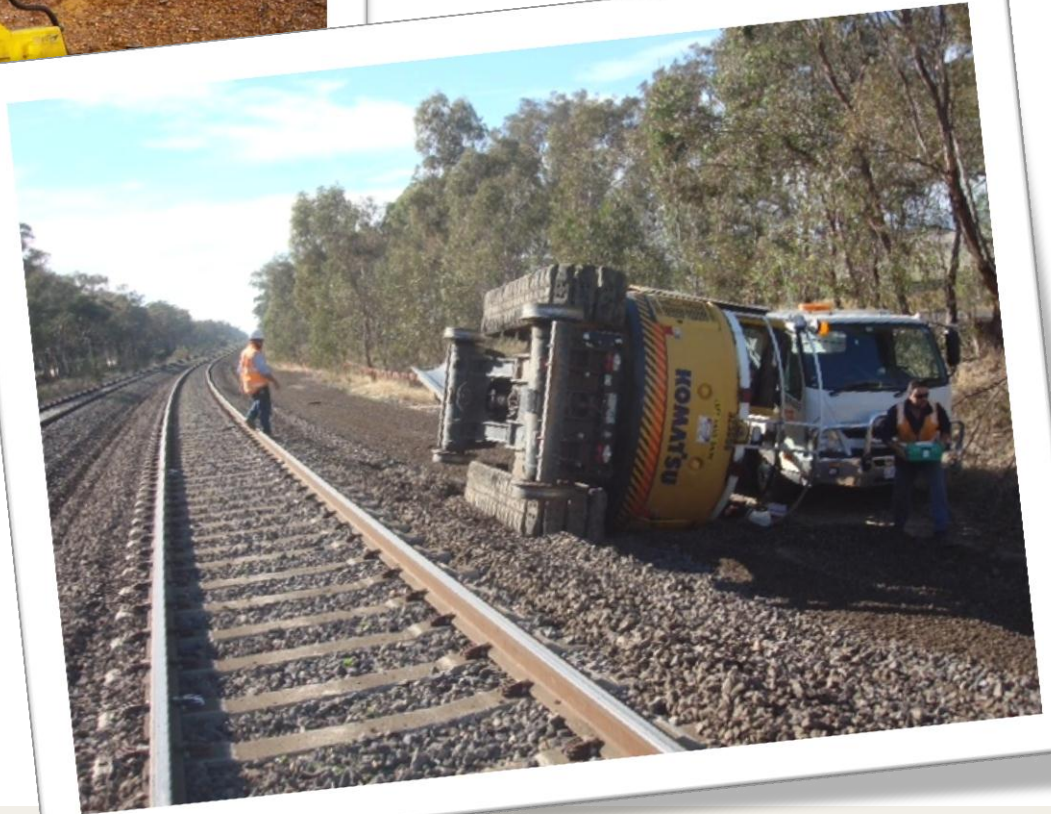
ONRSR expectations

Compliance activities

- Focus throughout 2014
- Will be included in all programmed audits – systems and hazard analysis
- Additional compliance inspections – focused site inspection periods.

Results

- Knowledge sharing
 - Better knowledge of the number/ type and use of RRVs
 - Better understanding of the National Risk profile of RRV Operations
- Improve RRV Safety through improved knowledge and risk based actions



End presentation