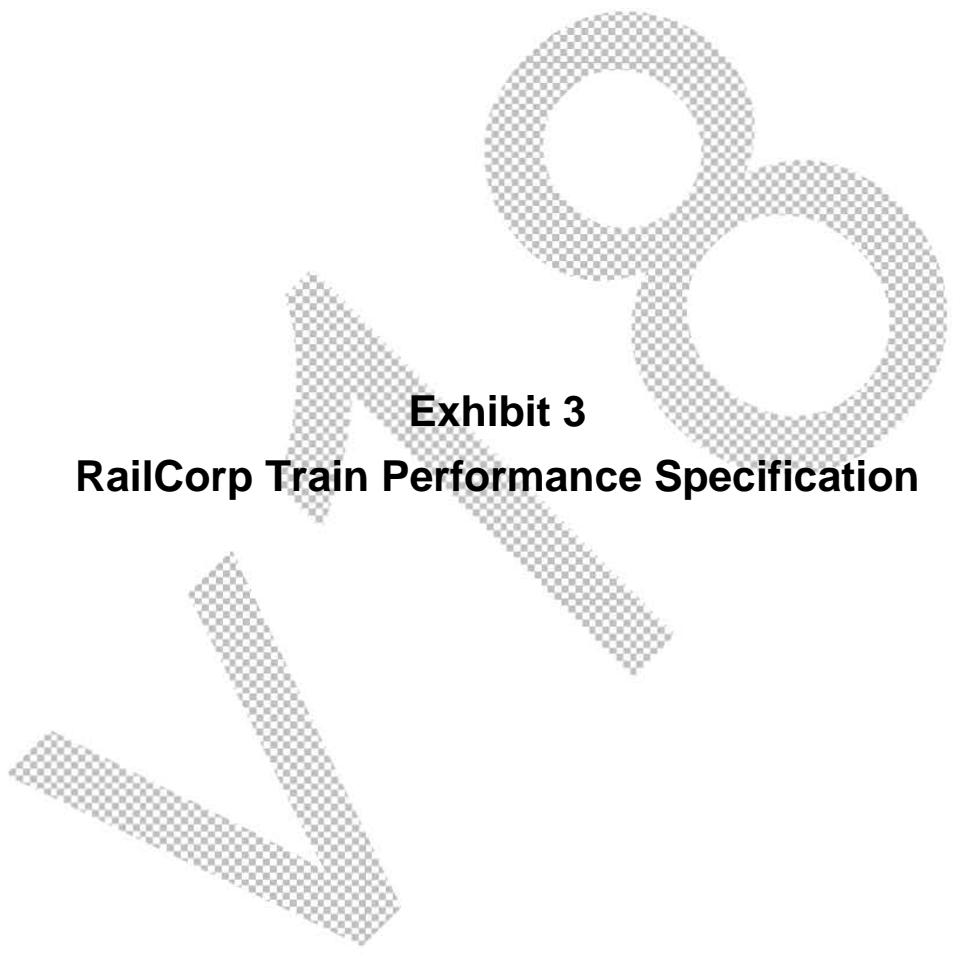


**Rolling Stock PPP  
Double Deck Trains**

**Exhibit 3  
RailCorp Train Performance Specification**



**Change Log**

Issue	Date	Author	Change
v9	CONTRACT		
v10	29/09/2008	CJEH	Addition of text changes from RFTA Group 1: 00004            00070            00105 00006            00071            00106 00010            00073            00110 00017            00074            00111 00023            00076            00119 00029            00079            00120 00031            00080            00127 00035            00081            00132 00037            00082            00140 00039            00089            00147 00045            00090            00148 00047            00091            00154 00057            00092            00160 00058            00093            00161 00064            00097            00164 00067            00098            00193 00068            00100            00195

Issue	Date	Author	Change
v11	18/11/2008	CJEH	<p>Addition of text changes from RFTA Group 1: 000158</p> <p>Addition of text changes from RFTA Group 2: 00040                      00109                      00167 00050                      00112                      00208</p> <p>Addition of text changes from RFTA Group 3: 00030                      00072                      00194 00046                      00086                      00207 00069                      00122                      00209</p>
v12	11/02/2009	ARJS	<p>Addition of text changes from RFTA Group 5: 00036                      00055                      00133 00136                      00142                      00188 00235                      00238</p> <p>Addition of text changes from RFTA Group 6: 00244                      00247</p>
v13	17/03/2009	ARJS	<p>Addition of text changes from RFTA Group 7: 00066                      00162                      00169 00191                      00220                      00231 00242                      00245                      00257 00283</p> <p>Addition of text changes from RFTA Group 8: 00012                      00032                      00043 00237                      00241                      00246 00248                      00253                      00255 00289</p>

Issue	Date	Author	Change																					
v14	08/04/2009	ARJS	<p>Addition of text changes from RFTA Group 9:</p> <table border="0"> <tr> <td>00011</td> <td>00118</td> <td>00170</td> </tr> <tr> <td>00192</td> <td>00234</td> <td>00236</td> </tr> <tr> <td>00240</td> <td>00252</td> <td>00259</td> </tr> <tr> <td>00280</td> <td>00282</td> <td>00287</td> </tr> <tr> <td>00308</td> <td></td> <td></td> </tr> </table> <p>Note: RFTA 00291 of Group 9 amends the Train Design Book, Section 11.3.</p> <p>Addition of text changes from RFTA Group 10:</p> <table border="0"> <tr> <td>00024</td> <td>00300</td> <td>00301</td> </tr> <tr> <td>00302</td> <td>00312</td> <td></td> </tr> </table>	00011	00118	00170	00192	00234	00236	00240	00252	00259	00280	00282	00287	00308			00024	00300	00301	00302	00312	
00011	00118	00170																						
00192	00234	00236																						
00240	00252	00259																						
00280	00282	00287																						
00308																								
00024	00300	00301																						
00302	00312																							
v15	04/05/2009	ARJS	<p>Addition of text changes from RFTA Group 11:</p> <table border="0"> <tr> <td>00087</td> <td>00139</td> <td>00260</td> </tr> <tr> <td>00284</td> <td>00299</td> <td>00303</td> </tr> <tr> <td>00309</td> <td></td> <td></td> </tr> </table> <p>Notes:</p> <p>RFTA 00003 of Group 11 exercises RailCorp rights under TPS clause 6.2.13.3 to delete the second set of steps based on DEDIR's analysis of gauge infringement as stated in CER 01014 Rev B. No text changes to TPS.</p> <p>RFTA 00151 of Group 11 amends the Train Design Book, Section 9.11.</p> <p>RFTA 00290 of Group 11 amends the Train Design Book, Section 11.10.4.</p>	00087	00139	00260	00284	00299	00303	00309														
00087	00139	00260																						
00284	00299	00303																						
00309																								

Issue	Date	Author	Change																																				
v16	30/06/2009	ARJS	<p>Addition of text changes from RFTA Group 12:</p> <table border="0"> <tr> <td>00041</td> <td>00042</td> <td>00056</td> </tr> <tr> <td>00075</td> <td>00281</td> <td>00306</td> </tr> <tr> <td>00314</td> <td>00315</td> <td>00323</td> </tr> </table> <p>Addition of text changes from RFTA Group 13:</p> <table border="0"> <tr> <td>00059</td> <td>00061</td> <td>00063</td> </tr> <tr> <td>00172</td> <td>00285</td> <td>00340</td> </tr> </table> <p>Addition of text changes from RFTA Group 14:</p> <table border="0"> <tr> <td>00002</td> <td>00137</td> <td>00286</td> </tr> <tr> <td>00318</td> <td>00333</td> <td></td> </tr> </table> <p>Addition of text changes from the following (ungrouped) RFTAs:</p> <table border="0"> <tr> <td>00013</td> <td>00014</td> <td>00022</td> </tr> <tr> <td>00096</td> <td>00130</td> <td>00198</td> </tr> <tr> <td>00223</td> <td>00225</td> <td>00227</td> </tr> <tr> <td>00229</td> <td>00230</td> <td>00319</td> </tr> <tr> <td>00320</td> <td>00322</td> <td>00338</td> </tr> </table> <p>Notes:</p> <p>RFTA 00041 of Group 12 also amends the Train Design Book, Section 8.1.</p> <p>RFTA 00137 of Group 13 also amends the Train Design Book, Section 9.10.</p> <p>RFTA 00223 also amends the Train Design Book, Sections 3.5.2, 3.5.6.1 &amp; 11.10.1.</p> <p>RFTA 00227 also amends the Train Design Book, Section 13.9 and Project Contract, Section 1.1 – Definition of “<i>Predicted Mass</i>”.</p> <p>RFTA 00310 of Group 12 amends the Train Design Book, Section 7.4.10.</p> <p>RFTA 00316 of Group 13 amends the Train Design Book, Section 6.6.2.</p> <p>RFTA 00317 of Group 12 amends the Train Design Book, Section 5.4.1.</p> <p>RFTA 00322 also amends Project Contract, Section 1.1 – Definition of “<i>Predicted Mass</i>”.</p> <p>RFTA 00350 of Group 13 amends the Train Design Book, Section 10.3.16.</p> <p>Formal inclusion of text changes arising from letter RC00273 dated 27/06/2007 – <i>Pre-agreed Variation</i>.</p>	00041	00042	00056	00075	00281	00306	00314	00315	00323	00059	00061	00063	00172	00285	00340	00002	00137	00286	00318	00333		00013	00014	00022	00096	00130	00198	00223	00225	00227	00229	00230	00319	00320	00322	00338
00041	00042	00056																																					
00075	00281	00306																																					
00314	00315	00323																																					
00059	00061	00063																																					
00172	00285	00340																																					
00002	00137	00286																																					
00318	00333																																						
00013	00014	00022																																					
00096	00130	00198																																					
00223	00225	00227																																					
00229	00230	00319																																					
00320	00322	00338																																					

Issue	Date	Author	Change
v17	02/09/2010	ARJS	Addition of text changes from RFTA: 00351                      00352                      00353 00354                      00355                      00359
v18	17/01/2011	ARJS	Addition of text changes from RFTA: 00362                      00363                      00366 00367                      00372                      00393 Note: RFTA 00361 amends the Train Design Book, Section 11.5. RFTA 00366 amends the Train Design Book, Section 11.5 – Public Address System , Public Address Modelling, Section 11.5.6 – PA Modelling and Section 11.8.1 – Speakers in Passenger Areas.

**Contents**

**1 Standards, Specifications and Drawings.....10**

1.1 Standards and Specifications ..... 10

1.2 Drawings ..... 15

1.3 List of Tables..... 16

1.4 Appendices ..... 16

**2 Scope.....18**

2.1 Introduction ..... 18

2.2 Set Configuration ..... 18

2.3 Interpretation of the Document and Standards..... 18

**3 General Requirements .....19**

3.1 Safety ..... 19

3.2 Environmental ..... 19

3.3 Working Environment..... 20

3.4 RailCorp Staff..... 21

3.5 Information and Communications Technology (ICT) ..... 21

**4 Interface Requirements .....27**

4.1 Existing Vehicles ..... 27

4.2 Rail Network ..... 27

4.3 Power Source..... 29

4.4 Stations and Platforms..... 29

4.5 Rolling Stock Outline..... 29

4.6 Signalling..... 29

4.7 Emergency Equipment and Maintenance Facilities..... 29

4.8 Washplant ..... 29

**5 Operational Characteristics .....30**

5.1 Performance..... 30

5.2 Energy Consumption ..... 30

5.3 Security ..... 32

5.4 Operational States ..... 35

**6 Carriage Body Configuration .....38**

6.1 Materials..... 38

6.2 Body ..... 38

6.3 Ballast Impact..... 48

6.4 Bogie ..... 48

6.5 Coupling and Drawgear ..... 51

6.6 Windows..... 53

6.7 Doors..... 55

6.8 Crashworthiness ..... 72

6.9 Fire Performance ..... 73

6.10 Fire Detection..... 75

6.11 Cleanliness, Vandalism and Graffiti ..... 75

6.12 Corporate Information and Advertising ..... 76

**7 Train Crew Requirements.....78**

7.1 The Driver’s Cab ..... 78

7.2	Crew Workstations .....	79
7.3	Crew Controls .....	81
7.4	Train Operating System .....	84
7.5	Maintenance.....	85
7.6	Event Recorder .....	86
7.7	Guard’s Cab .....	86
7.8	Guard's Station .....	86
7.9	Driver’s Safety System.....	88
7.10	Isolation of Equipment and Emergency Equipment.....	90
7.11	Guard’s Cab – Pre-Agreed Variation .....	92
<b>8</b>	<b>Power and Electromagnetic Compatibility .....</b>	<b>94</b>
8.1	Electromagnetic Compatibility.....	94
8.2	Main Power Supply (MPS).....	94
8.3	High Speed Circuit Breaker .....	96
8.4	Protection .....	97
8.5	Earthing.....	97
8.6	Earth Connection .....	97
8.7	Earthing arrangements for maintenance staff safety .....	97
<b>9</b>	<b>Auxiliary System .....</b>	<b>98</b>
9.1	Electrical Auxiliary Power Supply.....	98
9.2	EAPS Batteries .....	99
9.3	Battery Charging .....	101
9.4	EAPS Protection .....	101
9.5	Auxiliary Circuits.....	102
9.6	Remote Supply.....	102
9.7	Air Compressor Subsystem .....	102
9.8	Power Points .....	104
9.9	Flexible Hoses and Connections .....	104
9.10	Lighting.....	104
9.11	Passenger Lights .....	107
9.12	Passenger Exit Light .....	108
9.13	Cupboard Lights.....	108
9.14	Crew Lights .....	108
9.15	Timetable and Task Lighting .....	108
9.16	Guards Blue Light .....	108
9.17	Step Light Illumination.....	108
9.18	Emergency Passenger Lights .....	109
9.19	Emergency Step and Ramp Light Illumination.....	109
9.20	Headlights .....	109
9.21	Fog Lights .....	110
9.22	Marker Lights .....	110
9.23	Coupler Lights .....	111
9.24	Lighting Controls .....	111
9.25	Heating Ventilation and Air Conditioning .....	111
<b>10</b>	<b>Traction and Braking System .....</b>	<b>115</b>
10.1	Dynamic Performance .....	115
10.2	Traction .....	118



---

10.3	Braking .....	123
10.4	Wheel Slide Protection.....	126
<b>11</b>	<b>Communication System .....</b>	<b>129</b>
11.1	General Requirements.....	129
11.2	Crew Communication Interface.....	130
11.3	Timetable Changes .....	131
11.4	Public Address and Intercommunication System .....	132
11.5	Public Address System .....	135
11.6	Bell System .....	137
11.7	Door Warning Device (DWD).....	137
11.8	Speakers .....	138
11.9	External Horn .....	139
11.10	Closed Circuit Television (CCTV) .....	140
11.11	Digital Voice Annunciator .....	147
11.12	Radio Systems .....	150
11.13	PPP Co Data Link .....	153
11.14	Commercial Radio.....	153
11.15	Global Positioning Satellite System (GPS).....	154
11.16	In-Car Visual Passenger Information Displays .....	155
11.17	Set Headboard Information.....	157
<b>12</b>	<b>Mock-Ups .....</b>	<b>158</b>
12.1	Interior Design Workshops.....	158
12.2	Required Mock-Ups .....	158
12.3	Mock-Up Consultation.....	158
<b>13</b>	<b>Future Support for Design Life .....</b>	<b>160</b>
13.1	General Requirements.....	160
13.2	Driver Only Operation .....	160
13.3	Spare Cables and Wiring .....	161
13.4	Electrical Auxiliary Power Supply Reserve Capacity .....	161
13.5	Miniature Circuit Breaker (MCB) Spare Capacity .....	161
13.6	Train Operating System Expansion .....	161
13.7	Not used.....	162
13.8	Digital Train Radio Equipment (DTR) .....	162
13.9	Future Automatic Train Protection (ATP) and Automatic Train Control (ATC).....	163
13.10	Train Speed Protection Equipment.....	164
13.11	Global Positioning System.....	164
13.12	Platform Screen Door Interface .....	164
13.13	Acoustic monitoring equipment.....	165

**1 Standards, Specifications and Drawings**

**1.1 Standards and Specifications**

Number	Description
-	CityRail Design Guide
ADR 50/00	Australian Design Rules – Issued by Vehicle Standards, Driver and Vehicle Policy Branch, Roads and Traffic Authority of New South Wales
AS 1085.1	Railway track material - Steel rails
AS 1319	Safety signs for the occupational environment
AS 1324.1	Air filters for use in general ventilation and air conditioning – Application, performance and construction
AS 1324.2	Air filters for use in general ventilation and air conditioning – Methods of test
AS 1428.1	Design of Access and Mobility – General requirements for Access new Building work
AS 1530 Part 4	Methods for fire tests on building materials, components and structures - Fire-resistance tests of elements of building construction
AS 1627	Metal finishing - Preparation and pre-treatment of surfaces – Method selection guide
AS 1939	Degrees of protection provided by enclosures for electrical equipment (IP Code)
AS 2670	Evaluation of human exposure to whole body vibration.
AS 2700	Colour Standards for general purposes
AS 2080	Safety glass for land vehicles
AS/NZS 60598	Approval and test specification - Luminaries (light fittings)
AS 3837	Method of test for heat and smoke release rates for materials and products using an oxygen consumption calorimeter
AS 3856.1	Hoists and Ramps for people with disabilities – vehicle mounted
AS 4360	Risk Management
AS 4586	Slip resistance classification of new pedestrian surface materials
AS 5039	Security Screen Doors and Security Window Grills
AS 60529	Degrees of protection provided by enclosures (IP Code)
AS 61508	Functional Safety of Programmable Electronic Safety Related Systems
BS 2618	Specification for Electric Traction Equipment
BS 6853	Code of Practice for Fire Precautions in the Design and Construction of Passenger Carrying Trains

RFTA  
00253

RFTA  
00253

Number	Description
C 2009	Base Operating Condition Standards of Track Geometry
C 2010	Operating Safety Standards for Track
C 2011	Base Operating Condition Standards of Track Geometry – Standing Orders
C 2108	Clearances at Platforms
C 2200	Mainline Track Geometry
C 2447	Track Examination: Examination of Rail Wear
C 3200	Rail Grinding Plain Track
C 4750	Specification – Signals, Track Warning
CMMI	Capability Maturity Model Integration
DIN 4150 – Part 3	Structural Vibration
DIN EN 349	Minimum gaps to avoid crushing of parts of the human body
DoDAF	Department of Defense Architecture Framework
DSAPT	Disability Standards for Accessible Public Transport 2002 and Amendment 2004 No. 1 and No. 2
EIA 632	Processes for Engineering a System
EI 166	Interior Notice Location - Tangara Suburban and Outer Suburban Cars
EI 185	Electrical Equipment Cupboard Warning Signs
EN 14752	Railway Applications – Bodyside Entrance Systems
EN 50128	Railway Applications - Communications, Signalling and Processing Systems - Software for Railway Control and Protection Systems
<del>ENV 50121-1</del>	<del>Railway applications, general</del>
<del>EN 50121-1:2006</del>	<del>Railway Applications - Electromagnetic Compatibility - Part 1: General</del>
<del>ENV 50121-3-1</del>	<del>Railway applications, rolling stock, train and complete vehicle</del>
<del>EN 50121-3-1:2006</del>	<del>Railway Applications - Electromagnetic Compatibility - Part 3-1: Rolling Stock - Train and Complete Vehicle</del>
<del>ENV 50121-3-2</del>	<del>Railway applications, rolling stock, apparatus</del>
<del>EN 50121-3-2:2006</del>	<del>Railway Applications - Electromagnetic Compatibility - Part 3-2: Rolling Stock - Apparatus</del>
EN 50126	Railway applications. The specification and demonstration of reliability, availability, maintainability and safety (RAMS)
EN50129	Railway applications. Communication, signalling and processing systems. Safety related electronic systems for signalling
ENV 50166	Human exposure to electromagnetic fields. Low frequency (0 Hz to 10 kHz)
EN 62233	<u>Measurement Methods for Electromagnetic Fields of Household Appliances and Similar Apparatus With Regard to Human Exposure...</u>

RFTA  
00041

RFTA  
00042

Number	Description
FE 023	Fluorescent Lighting Inverter Ballasts
FE 027	Lighting Diffusers Used in CityRail Rolling Stock
FE 038	2 & 3 Passenger Walk-Over Seat
FE 087	Floor Panels for Rolling Stock
FE 101	Specification for Air Brake Hose
FE 103	Specification for Flammability Requirements for Materials used in the Construction and Fitting out of Passenger Rolling Stock
FE 106	Wiring and Cable Specification for New Passenger Rolling Stock and Equipment
FE 107	Specification for Windscreens for Electric Passenger Rolling Stock
FE 108	Specification for Windows for Electric Passenger Rolling Stock
FE 116	General Principles, Construction, Mounting and Installation of Electrical Equipment for Electric Passenger Rolling Stock
FE 117	Electrical Circuits and Equipment for Passenger Rolling Stock
FE 119	Specification for the Interface between the Electric Rolling Stock and Overhead Electrical Power Supply
FE 152	Vigilance Control Generic Functional Specification
FRA Spec 49 CFR Part 223	Safety Glazing Standards - Locomotives, Passenger Cars and Caboose
GM/RT2100	Structural Requirements for Railway Vehicles
GM/RT2456	Structural requirements for windscreens and windows on railway vehicles
GM/RT 2457	Structural Requirements for Doors and Gangways on Railway Vehicles
HB40-1992	Australian Refrigeration and Air Conditioning Code of Good Practice.
HB221:2004	Business Continuity Management
RFTA 00080	<del>IEC 1287</del> <u>Power converters installed on board Rolling Stock Railway applications – Power converters installed on board rolling stock</u>
RFTA 00081	<del>IEC 146</del> <u>International Electrical Code – Semiconductor Convertors: General Requirements and Line Commutated Convertors</u> <del>IEC 60146</del> <u>Semiconductor converters - General requirements and line commutated converters</u>
RFTA 00082	<del>IEC 494</del> <u>Rules for pantographs of electric rolling stock Railway applications – Rolling stock – Pantographs – Characteristics and tests – Part 1: Pantographs for mainline vehicles</u>
RFTA 00080	<del>IEC 61287 TS</del> <u>Power Converters Installed On-Board Railway Rolling Stock</u>
IEC 62279	Railway Applications. Communications, Signalling and Processing Systems – Software For Railway Control and Protection Systems.

RFTA 00105	Number	Description
	<del>IEC 77</del>	<del>Specification for Electric Traction Equipment Railway Applications -</del>
	<u>IEC 60077</u>	<u>Electric Equipment for Rolling Stock</u>
	IEEE 802.11	Wireless LAN Standard
	ISO/IEC 27001	Information Security Management - Specification With Guidance for Use
	ITIL	IT Infrastructure Library
	MIL-STD-498	Military-Standard 498 - Software Development & Documentation
	NF X 70-100	Fire Behaviour Tests – Analysis of pyrolysis and combustion gases - - Pipe still method
	NMEA 183	National Marine Electronic Association – Standard Protocols
	NOHSC:1001	National Standard for Manual Handling
	NOHSC:2005	National Code of Practice for Manual Handling
	RS SP-05-01-05-01-1	Specification for the design, manufacture and installation of an operator enabled pedal (OEP) (Document to be released upon authorisation by RailCorp)
	RSU 000	RSS 001 - Minimum Operating Standards for Rolling Stock
	RSU 100	Introduction
	RSU 110	Rolling Stock Outline Interface
	RSU 120	Track Interface
	RSU 140	Vehicle to Vehicle Interface
	RSU 150	Environmental Interface
	RSU 160	Signalling Interface
	RSU 211	Wheel Design and Manufacture
	RSU 221	Axle Design and Manufacture
	RSU 230	Wheel and Axle Assembly
	RSU 240	Axle Bearing Assembly
	RSU 250	Bogie Frame and Associated Components
	RSU 260	Vehicle Suspension
	RSU 261	Suspension Springs
	RSU 262	Suspension Damping
	RSU 263	Resilient suspension components
	RSU 289	Kinematic Rolling Stock Outline Test
	RSU 630	Body, Underframe and Appointments
	RSU 642	Vehicle Ride Performance
	RSU 650	Safety Equipment
	RSU Appendix D	Standard for Driver Safety Systems
	RSU Appendix E	Specification for 1500 V dc Traction Supply

---

<b>Number</b>	<b>Description</b>
RSU Appendix H	Automatic Equipment Identification
RSU Appendix I	Reflective Delineators
SC 00 18 00 00 SP	Rolling Stock Signalling Interface Requirements
TRS 0139	Manufacture of Wrought Steel Wheels for Locomotives and Rolling Stock
TRS 0147	Integrated Rolled Steel Wheels for High Speed Disc Braked Power and Trailer Cars
TS 0002 TI	Curve and Gradient Diagrams Book
TS 3103	Standard Track Construction
TS 3501	Turnouts - Components Definitions
TS 3502	Standard Turnouts
UIC Code 555	Electric Lighting in Passenger Rolling Stock
UIC 615-4	Motive power units, Bogies and Running Gear, Bogie frame structures and strength

**1.2 Drawings**

<b>Number</b>	<b>Description</b>
3-83-01736	WPR2000 Wheel Profile
CV0322308	CityRail Emergency Stairs
CV0322309	CityRail Emergency Stairs
206-928	Flags on Handles –flags without handles required to be provided
004-616	Standard Detonator Box
401-510 part M5-398	Lock
DO8641	Shunt Resistor Rail Clamp
305-827	Label for Bogie Code and Number
2-82-00651	Emergency Coupler Contour
0-66-00186	Interior Notice – Cars Fitted in Formation Sheet
0-66-01824	Interior Notice – Route Map (I/C and Millennium)
0-66-01826	Train Interior Notice Network Map Suburban and Tangara Cars – End Saloon
0-66-01827	Train Interior Notice – Network Map, Tangara Cars
3-66-00068	Interior Notice – No Forced Exit
3-66-00138	Interior Notice – Transverse and Crew Doors
3-66-00139	Interior Notice – Driver Door
3-66-00140	Interior Notice – Notice to Guards
3-66-00144	Interior Notice – Crew Emergency Exit
3-66-00163	Interior Notice – Driver Compartment
3-66-00182	Interior Notice – Stand Clear Doors Closing
3-66-00204	Interior Notice – Help Point
3-66-01649	Interior Notice – Smoke/Litter/Alcohol
3-66-01650	Interior Notice – 3 Panel Police/Feet/Litter
3-66-01652	Interior Notice – 7 Panel
3-66-01700	Interior Notice – Crew Cab Exit Detail
3-66-01822	Interior Notice – Ensure Firm Hold
4-66-00159	Interior Notice – Intercar Door Release
4-66-00161	Interior Notice – Wheelchair
4-66-00162	Interior Notice – When lit Press
4-66-00164	Interior Notice – Keep Hands Clear
96035	Electric Rolling Stock New Key for Master Controller

---

### 1.3 List of Tables

Table 1	Maximum external noise levels for static operation
Table 2	ICT Standards
Table 3	Set-borne Systems Transactions
Table 4	Loading Conditions
Table 5	Predicted Energy Consumption
Table 6	Access Levels and accessible equipment
Table 7	Maximum peak forces
Table 8	Performance of a Four Car Train in Collision with Similar Train
Table 9	RailCorp Route Maps
Table 10	Emergency Battery System
Table 11	Average and Minimum Illumination
Table 12	Deceleration Rates for Modes of Braking
Table 13	Ripple Detection System Parameter
Table 14	Timetable Transactions
Table 15	CCTV Transactions
Table 16	DVA Transactions
Table 17	Passenger Information Display Transactions

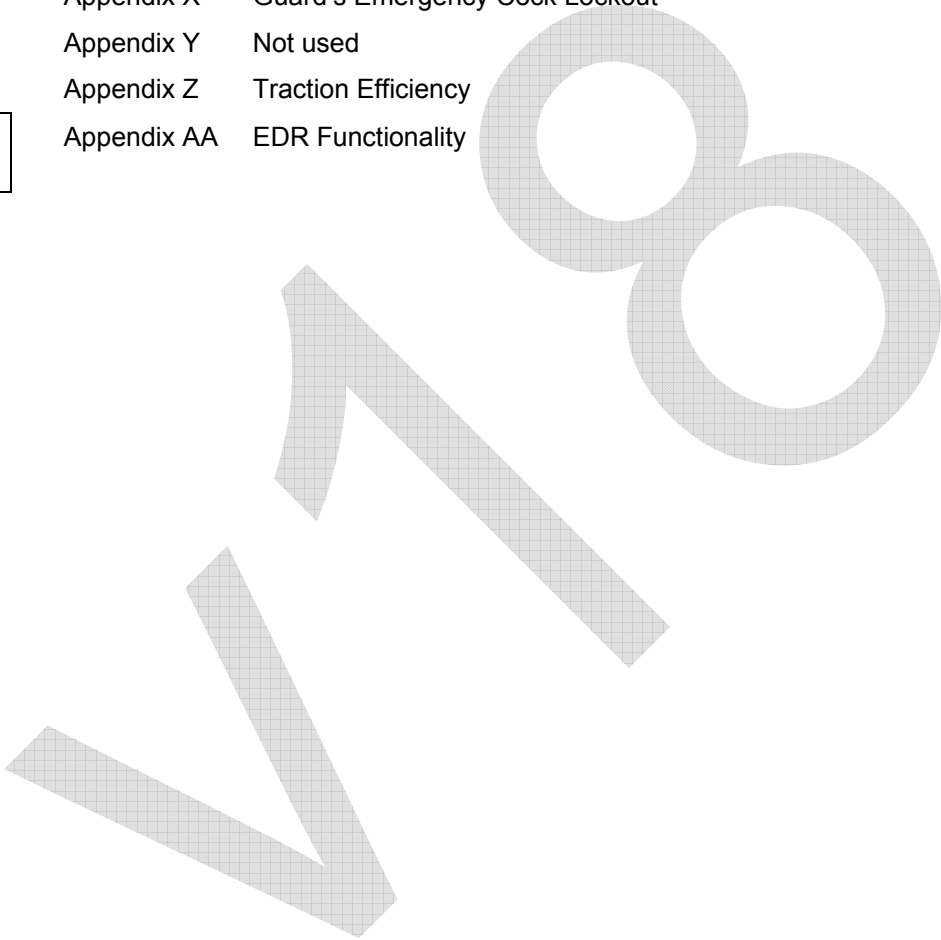
### 1.4 Appendices

Appendix A	Digital Voice Annunciator & Internal Destination Indicator Operation
Appendix B	Washplant Facilities
Appendix C	Routes and Timings
Appendix D	Door Positions and Axle Numbers
Appendix E	FEA and Fatigue Life Evaluation
Appendix F	Ride Quality
Appendix G	Anti-Climber
Appendix H	Cab Layout
Appendix I	Crew Controls
Appendix J	DDA Requirements
Appendix K	Train Operating System
Appendix L	TOS Hierarchy
Appendix M	TOS User Interface Screens
Appendix N	Event Recorder
Appendix O	Destination Indicator Viewing Envelope
Appendix P	PEI Signage



Appendix Q	Isolating Cock Positions
Appendix R	Control Switch Panels
Appendix S	Traction Controller Positions and Power
Appendix T	Crew Visibility
Appendix U	Train Emergency Equipment
Appendix V	Acceleration Performance
Appendix W	Millennium Train Internal Passenger Compartment
Appendix X	Guard's Emergency Cock Lockout
Appendix Y	Not used
Appendix Z	Traction Efficiency
Appendix AA	EDR Functionality

RFTA  
00022



## 2 Scope

### 2.1 Introduction

This RailCorp Train Performance Specification covers RailCorp's performance and functional requirements for the Sets to be supplied for the Sydney Metropolitan Area under the Contract.

RailCorp is seeking a new fleet to replace the existing non-airconditioned R, S and L Car Sets.

To a Passenger the Set appearance, comfort and performance shall, as a minimum, be equivalent to the latest vehicles in the Sydney metropolitan fleet (the "Millennium" trains).

Where no standards relevant to the requirements are indicated in this RailCorp Train Performance Specification or as alternatives if considered superior, PPP Co shall propose suitable recognised national or international standards for acceptance by RailCorp.

The Cars shall comply fully with this RailCorp Train Performance Specification unless RailCorp has directed or accepted a Variation from these requirements in accordance with clause 30 (RailCorp initiated Variations) or 31 (PPP Co initiated Variations) of the Conditions of Contract.

This RailCorp Train Performance Specification sets out RailCorp's minimum requirements, which must be met or exceeded by PPP Co in performing PPP Co's Activities.

### 2.2 Set Configuration

The Set configuration sought by RailCorp is an eight-Car electric multiple unit with full Driver's Cabs at each end.

Letter  
RC00273

~~The Guard's Cab shall be located in the centre of the Set on one of the two central Cars. PPP Co may provide an additional Guard's Cab in the centre of the Set. If an additional Guard's Cab is provided then this shall be at no additional cost to RailCorp.~~

The Set shall be designed to operate independently, and with the capability to operate coupled to another Set as a longer consist under emergency or recovery conditions.

All facilities and controls that are provided for the Guard shall be made available to the Driver unless agreed otherwise by RailCorp.

### 2.3 Interpretation of the Document and Standards

In the event of conflict between requirements stated in this RailCorp Train Performance Specification and the relevant Reference Documents, the requirements of this RailCorp Train Performance Specification shall be met unless otherwise agreed with RailCorp.

**3 General Requirements**

**3.1 Safety**

PPP Co shall supply Sets that meet the safety requirements of the Contract (including those set out in the Contract Management Requirements).

All safety critical components and systems shall be designed to ensure minimisation of error during maintenance, redundancy in operation and 'fail-safe' operation should any of the components or systems fail in service.

RFTA  
00158

The Set design shall ~~minimise the effect of single point Failure~~ avoid single point failure where possible, and reduce single point failure risks to ALARP. RailCorp prefers that train borne safety critical systems are hard wired and can operate without the need for software control. Design proposals including safety critical software may not be acceptable. No single point Failure of the Set controls shall cause the Driver not to be able to operate the Set from the leading Cab.

All exterior components shall be attached with the use of secondary restraints, redundant fixings, or secondary latches as appropriate to ensure that no single point failure can cause equipment to either physically detach or protrude out of gauge.

The design of the Set shall ensure that there is clear differentiation of electrical circuits within equipment lockers. Labelling and protection shall be provided to indicate the voltage levels within cabinets and this labelling shall be compliant with AS 1319. Any high voltage equipment shall be segregated. It shall not be necessary for Crew to access high voltage equipment to operate the Set (including fault finding and rectification).

**3.2 Environmental**

3.2.1 Trackside Noise Levels

RFTA  
00161

Noise levels under operation shall be reduced to 82 dB(A) at 80 km/h measured 15 m from the track centreline and shall otherwise be the minimum level practicable and shall be in compliance with RSU 150.

Further, noise levels under static conditions shall not exceed the noise limits as set out in Table 1 below:

Condition	External
Static under full auxiliary load	53 dB(A) at 30 m
Static in presentation state	50 dB(A) at 30 m
<b>Static with acoustic covers closed and maintenance covers open</b>	85 dB(A) at 0.5 m from Set and 0.8 m above top of rail

**Table 1: Maximum external noise levels for static operation**

- a) The presence of any significant tonal component shall not be permitted to exceed the requirements in RSU 150.

3.2.2 Vibration

RFTA  
00160

PPP Co shall ensure that the level of ground or air borne vibrations ~~is minimised and~~ shall meet the requirements in DIN 4150 Part 3.

3.2.3 Materials and End of Life Disposal

Without limiting clause 12.2 (Environmental Compliance) of the Conditions of Contract, PPP Co shall not use materials likely to cause environmental damage during the manufacture, maintenance, operation and disposal of the vehicles. The materials listed in this clause are a minimum list of restricted materials and

PPP Co shall provide adequate evidence to RailCorp that all materials used will not cause environmental damage.

PPP Co shall not use any of the following materials in the manufacture and maintenance of the Set:

- a) Asbestos;
- b) Chlorofluorocarbons (CFCs)\*;
- c) Polychlorinated Biphenyls (PCBs);
- d) Exposed Lead. Paints containing lead shall not be used;
- e) Chromates;
- f) Cadmium; and
- g) Cyanide.

*\* For the manufacturing of the Set, PPP Co shall not use products containing CFCs nor products manufactured by processes in which CFCs are used.*

PPP Co shall only use any of the following materials in the manufacture of the Set after referral to and agreement by RailCorp, which may be withheld at RailCorp's sole discretion.

- h) Ceramic Fibre;
- i) Rockwool;
- j) Urea Formaldehyde;
- k) Polyethylene Foam;
- l) Polyurethane Foam;
- m) Polyurethane Rigid Mouldings;
- n) PVC; and
- o) Encapsulated Lead.

PPP Co shall submit details, including material safety data sheets of all materials proposed to be used in the manufacture of the Set to RailCorp for concurrence.

PPP Co shall maximise the use of recyclable materials throughout the Set. PPP Co shall demonstrate, using the Life Cycle cost model, the economic trade-offs made between the cost of manufacture and maintenance versus the cost of disposal to PPP Co and/or RailCorp.

### **3.3 Working Environment**

#### **3.3.1 Airborne Pollution**

The Set shall operate in the air pollution conditions encountered throughout the operational area, which may include ozone, smoke and airborne particles. The origins of smoke and particles include bushfires as well as industrial, domestic and commercial sources.

The Set shall operate while subjected to wind driven dust at particle sizes, which may vary from 1.4 µm to 100 µm.

#### **3.3.2 Altitude**

The Set shall be able to operate at altitudes of between 32 m below sea level to 1150 m above sea level. RailCorp anticipates deeper tunnels in the future, PPP Co shall advise any restrictions on operation of the Set.

3.3.3 Climate Conditions

The Set shall be capable of continuous operation while maintaining the performance and the Passenger environment throughout the full range of climate conditions in the area covered by the Sydney electrified lines, without degrading its life expectancy, suffering permanent damage or degrading its ability to achieve the performance requirements of this RailCorp Train Performance Specification. The Sets shall be able to operate with the rail flooded by water or covered in snow up to 50 mm Above Rail Level, at reduced speed.

3.4 RailCorp Staff

There are a number of groups of staff who will interface with the Sets including; Drivers, Guards, Driver Trainers, Guard Trainers, Principal Guards, Principal Drivers, Operations Standards Managers, Presentation Staff, Security Staff, Maintenance Staff and Equipment Examiners. PPP Co shall develop a Set design, which provides for the needs, as identified during Mock-up consultation and Technical Review, of these RailCorp staff members.

RFTA  
00162

3.4.1 Ergonomics

PPP Co shall use NOHSC:2005 Manual Handling Code as the guidelines for the location of controls and all other normal and emergency equipment for Crew, Passengers, and other groups of staff.

3.5 Information and Communications Technology (ICT)

All train borne programmable electronic devices and associated data links shall be considered as ICT systems unless otherwise agreed with RailCorp. The following requirements shall apply to these systems.

3.5.1 Standards

PPP Co must demonstrate to the satisfaction of RailCorp that its ICT systems approach is compliant with the following standards (except to the extent that RailCorp agrees otherwise):

ICT Area	Standard
Architecture Methodology	DoDAF
Service Management Infrastructure	ITIL
System Life Cycle Process	EIA 632
Systems Engineering Practice	CMMI
Risk Management	AS 4360
Security Management	ISO/IEC 27001
Systems Integration	EIA 632, EN 50126 and EN50129
Software Safety	EN 50128
Software Requirements Specification	MIL-STD-498
Business Continuity Management	HB 221:2004

Table 2: ICT Standards

3.5.2 Avoidance of Proprietary Technologies

All ICT systems, subsystems, equipment and components shall exhibit the following characteristics:

- a) have publicly and readily available specifications for all aspects related to interoperability in multi-vendor ICT environments;
- b) are in current active maintenance and are generally regarded as good practice for the relevant purpose;

- c) are founded on underlying technology that is in widespread use and for which development/support/maintenance skills and training are broadly available in the Australian ICT market place;
- d) have more than one commercial source, so that reasonable competition exists in the market place for supply;
- e) shall be based on equipment and software built to open, non-proprietary standards that will remain supportable during the Contract Term; and
- f) shall remain certified, supported and maintained on the Upgrade Path during the Contract Term, regardless of enhancements that may be required.

Access to embedded source code for ICT systems, subsystems, equipment and components shall be maintained in accordance with clause 37 (Intellectual Property Rights) of the Conditions of Contract.

### 3.5.3 Connectivity to Public Systems

No ICT systems, subsystems, equipment and components shall interfere with or otherwise impact on the use of public mobile communication systems, while in normal coverage areas.

### 3.5.4 System Integration with RailCorp ICT Systems

All ICT systems, subsystems, equipment and components shall be capable of being safely, successfully and sustainably integrated into RailCorp ICT systems where they shall inter-operate.

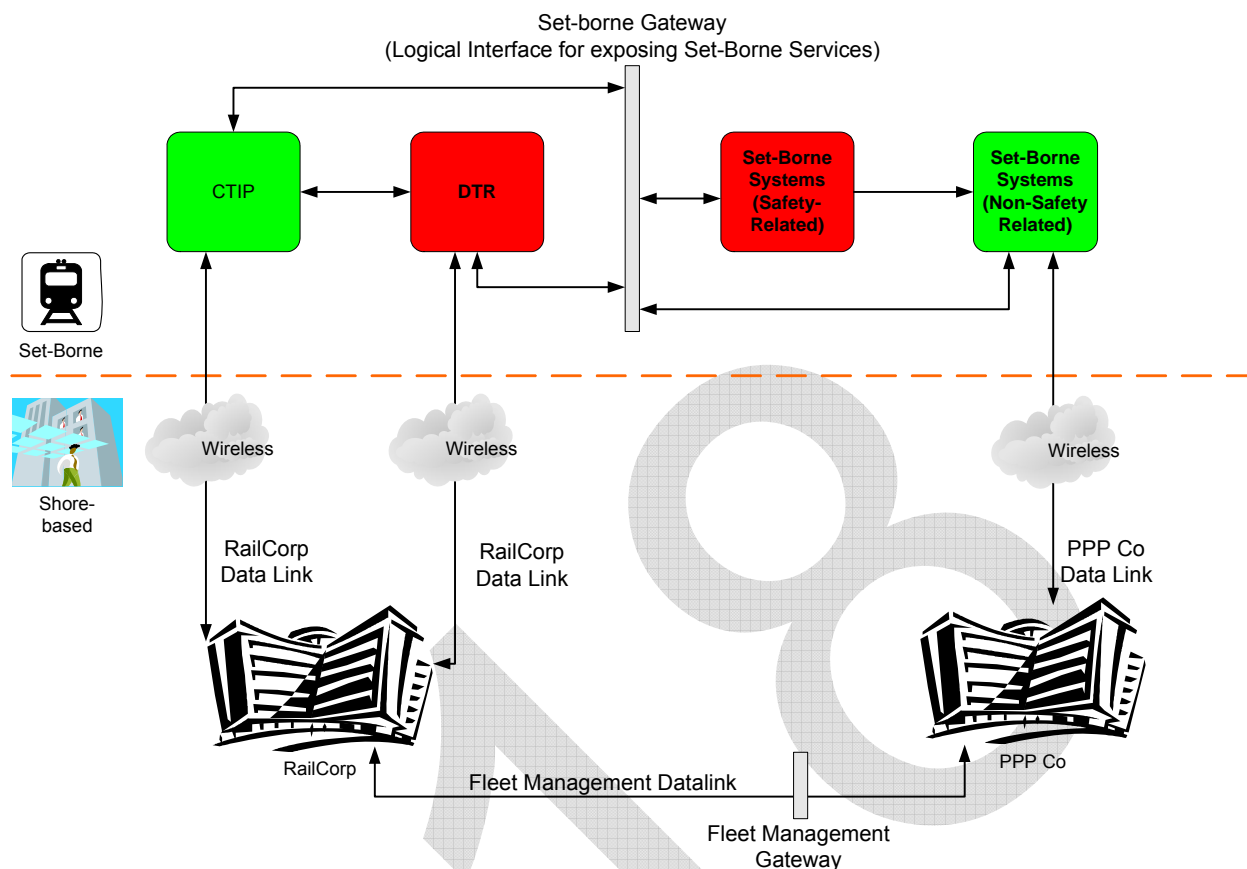
Any requirements for ICT components, environments or resources to be supplied by RailCorp to achieve the required level of system integration shall be stated clearly. This shall include proposed data schemas, expected data volumes to be handled across interfaces with RailCorp, requirements for connectivity approaches, bandwidth of communications links and any other relevant content details and related topics which may impact RailCorp's ICT infrastructure capacity.

RFTA  
00193

All interfaces with RailCorp ICT systems, subsystems, equipment and components shall be capable of supporting bi-directional ~~standards, protocols and~~ transfer of data.

Interfaces shall be compliant with the requirements of the IEEE Rail Transit Vehicle Interface Standards Committee, or accepted non-proprietary equivalent international, national or industry standards.

The diagram below illustrates the conceptual network access and integration points between the PPP Co, RailCorp and Set-borne ICT systems.



3.5.4.1 RailCorp Data Link

RFTA  
00194

The RailCorp Data Link shall will be provided and supported by RailCorp. The RailCorp Data Link is the access grouping point for remote system interactions with RailCorp Set-borne Systems and comprises the Digital Train Radio and CTIP access points.

The RailCorp Data Link supports both safety-critical and non-safety-critical remote access. Systems such as the Digital Train Radio (as described in clause 13.8 (Digital Train Radio) of this RailCorp Train Performance Specification) utilise the safety-critical capabilities, whilst systems such as CTIP (as described in clause 3.5.6 (Common Telemetry Infrastructure Platform) of this RailCorp Train Performance Specification) utilise the non-safety-critical capabilities.

3.5.4.2 Set-borne Gateway

PPP Co shall provide and support a Set-borne Gateway as the bi-directional gateway through which RailCorp Set-borne systems shall interact with PPP Co Set-borne systems.

PPP Co shall in consultation with RailCorp define and implement the Set-borne Gateway to support RailCorp and PPP Co requirements for Set-borne system interactions as discrete services.

The Set-borne Gateway supports both safety-related and non-safety related transactions. RailCorp does not envisage safety-critical transactions being performed through the Set-borne Gateway but rather through traditional hard-wired and electro-mechanical methods.

PPP Co shall ensure that utilisation of the Set-borne Gateway cannot adversely impact the safety or performance of the PPP Co on-Set systems in any way.

PPP Co shall for each service exposed by the Set-borne Gateway provide document details such as, the identification and description of the:

- (a) system responsible for executing the service;
- (b) data exchange associated with each service execution;
- (c) description of all pre-conditions, effects and results of service execution; and,
- (d) service level characteristics supported by the service, such as: data volumes, timeliness of updates, scalability, responsiveness (or time to complete), and security requirements.

PPP Co shall ensure that services exposed by the Set-borne Gateway are implemented in such a way that service execution does not block the parallel execution of other services. For example, lengthy operations such as a timetable upload or a bulk download of event history must not prevent the Set-borne Gateway transmitting updates such as a door event or odometer reading, or prevent receiving updates such as passenger display information.

PPP Co shall implement a comprehensive Transaction Management framework that will make maintenance easier and improve the service level capabilities of the Set-borne Gateway and shall include features such as:

- (e) tracking the progress, successful or otherwise, of messages passing through the interface;
- (f) the logging of all messages as an audit record and maintaining the message history for later review and analysis; and
- (g) audit samples of messages passing through the interface for pro-active detection of increased error rates and other faults.

**3.5.4.3 List of Transactions**

The PPP Co Set-borne systems and subsystems shall expose to the Set-borne Gateway, services such as:

Transaction	Description	From	To	Frequency of Transaction
Publish events	Expose all event data being sent to the Event Recorder to the Set-borne Gateway	PPP Set	RailCorp	Frequently (>3 per day)
Publish events	Expose all event data being recorded by the TOS to Set-borne Gateway	PPP Set	RailCorp	Frequently (>3 per day)

**NOTE: System/subsystem transactions are defined in their relevant clauses and are not repeated in this table.**

**Table 3: Set-borne Systems Transactions**

The services listed in Table 3 shall publish information in a common message format.

**3.5.5 Safety Systems**

All ICT systems, subsystems, equipment and components that have safety attributes, or have interfaces to RailCorp ICT systems (whether explicitly related to safety or not), shall be identified and shall comply with EN 50128 or an accepted non-proprietary equivalent international, national or industry standard. Any safety related data transferred from any ICT systems, subsystems, equipment and components to any RailCorp ICT system, by any means, shall also be clearly identified.



3.5.6 Common Telemetry Infrastructure Platform

RailCorp is presently developing the Common Telemetry Infrastructure Platform (CTIP) as a “future” shared computing platform for non-critical on-train applications. RailCorp intends at some future time to progressively deploy CTIP onto all rolling stock.

PPP Co must ensure that all Sets have the capability, without further modification and at no additional cost to RailCorp, to support the provisions for integration of CTIP as described in the following clauses.

3.5.6.1 Configuration

PPP Co must make provision to fit CTIP modules to every Set as per the following configuration:

(i) Two 'headless' units in each Set.

Headless units:

- (1) come without screen;
- (2) must be located in an equipment rack with like equipment or similar location where suitable environmental conditions are maintained and cabling to the required systems can be provided;
- (3) perform identical functions - thereby further improving reliability though redundancy; and
- (4) shall be allocated an approximate size of 300 mm x 300 mm x 300 mm in an enclosure with ventilation appropriate for equipment consuming up to 20W.

(ii) ~~Not Used One 'head' unit in each Driver's Cab and one 'head' unit in each Guard's Cab.~~

~~Head units:~~

- ~~(5) Not used are supplied with a small flat panel touch screen;~~
- ~~(6) Not used enable Drivers and Guards to interact with the system; and,~~
- ~~(7) Not used shall be allocated an approximate size of 250 mm x 300 mm x 110 mm and must be mounted in a position suitable for operator interaction with the system.~~

The Crew interface for the following CTIP functionality shall be provided by the TOS:

- (8) The ability for a Guard to view the content of an announcement sent to the Set on the GDU and either play or discard the announcement. The corresponding Guard's action shall be logged as an event in TOS;
- (9) Provision of a notification on the GDU and the DDU that a remote transposition has been applied. The message will be flagged as either requiring acknowledgement or not. If acknowledgment is required, then the associated acknowledgment shall be logged as an event in TOS.
- (10) The ability to display a message on the GDU and / or the DDU of supplied message text sent via the Set Borne Gateway. As a minimum, the capability of displaying text messages up to 80 characters shall be provided. The message will be flagged as either requiring acknowledgement or not. If acknowledgment is required, then the associated acknowledgment shall be logged as an event in TOS.
- (11) Provision for the operational status of both CTIP headless units to be checked as part of the Set's self-test and continuously monitored when the Set is in Normal state and the crew shall be notified of either a CTIP control failure or a CTIP link to Set Borne Gateway failure.

RFTA  
00223

3.5.6.2 CTIP Antenna

Remote interactions between RailCorp shore-based systems and CTIP will occur via the RailCorp Data Link.

The PPP Co. shall supply and install antennae, conduits and cabling for the CTIP component of the RailCorp Data Link.

The CTIP antenna shall have the requisite bandwidth and performance characteristics to utilise the GSM, CDMA, 3G and 802.11 bands existing or planned throughout the areas in which the Set may operate.

Each antenna mounted to the Set shall be located and connected to optimise antenna performance taking into account issues such as:

- (i) the antenna's angle of view (coverage);
- (ii) proximity to other antennae (e.g. interference, desensitisation, etc);
- (iii) signal loss in cabling;
- (iv) ground plane requirements;
- (v) protection from damage;
- (vi) ease of maintenance; and,
- (vii) reliability and robustness.

PPP Co shall ensure the antennae comply with clause 4.5, and are resistant to damage by washplants.

3.5.6.3 Cabling

PPP Co shall establish the cabling for a redundant high-speed data network (of at least 100Mbps) for the CTIP devices and this cabling must be dedicated and not part of a shared Set network.

~~PPP Co shall provide cabling between CTIP mounting points so that CTIP head and headless units can communicate.~~

~~PPP Co shall provide suitable cabling between the CTIP units and the CTIP antenna, allowing remote access from shore based systems to any Set borne CTIP head or headless unit.~~ Integration of the CTIP antenna and CTIP units.

All cabling is to be of a type that is industry standard and non-proprietary in nature.

3.5.6.4 Power Supply

PPP Co shall provide power to each CTIP unit whenever the Set is not stabled. Each ~~CTIP head unit shall be provided with not less than 80 W~~ and each CTIP headless unit shall be provided with not less than 60 W from the control battery supply.

3.5.6.5 Interface to PPP Co Set-borne Systems

CTIP requires access to services provided by PPP Co Set-borne systems such as the DVA System. PPP Co shall expose services to CTIP utilising the Set-borne Gateway as a single point of access. PPP Co shall ensure that CTIP is unable to negatively impact the access and performance characteristics of on-Set services provided by PPP Co.

RFTA  
00223  
RFTA  
00195

## 4 Interface Requirements

### 4.1 Existing Vehicles

The Set shall be able to push or pull another Set or any existing RailCorp AW3 loaded eight-Car train with a tare mass of 430 tonnes, using (if required) a coupling adaptor that shall be carried on the Set, and in the case when an existing train has broken down. The AW3 load for an existing RailCorp 8-car train is 2244 passengers. The Set shall be capable of being towed and braked by an assisting train having compatible automatic braking system and adequate power. Coupling shall be mechanical and pneumatic and PPP Co shall ensure that, with the exception of clause 11.1 Passenger Vehicles of RSU 140, all requirements of RSU 140 are met. The coupler centre line height above rail level in the tare condition with new wheels shall be 865mm +25/-12mm.

RFTA  
00004

The brake system shall be fail safe and be compatible with a hauling vehicle having a Brake Pipe release pressure set at 500 kPa.

The Set shall be able to provide sufficient air pressure, air quality and responsiveness for the Automatic Brake to be coupled to existing trains.

### 4.2 Rail Network

The Sets supplied shall be able to operate on the New South Wales electrified rail network track with limiting parameters as set out in RSU 100 series and the other standards described in this clause. Provision shall be made for the potential requirement of Sets to be towed in non-electrified areas of the Sydney Metropolitan Area.

#### 4.2.1 Track

The Set shall be compliant with track built and maintained to the following standards:

- a) Standard Track Gauge and classes (TS3103); and
- b) Grades and Curvatures (C.2200).

However, RailCorp does not represent or warrant that the track has been, or will be, built or maintained to these standards. The typical design for turnouts and crossovers are shown in TS 3501 and TS 3502.

##### 4.2.1.1 Rail Profile

New rail is of standard profile as detailed in AS1085.1 and generally ground to the profiles as defined in RailCorp Specification C3200. Rail wear is monitored and reported as detailed in RIC Practices and Procedures Manual C2447.

##### 4.2.1.2 Sample Track Data

Rail Corp has provided sample track data in electronic form as an Information Document. Additional track data including inertial track data (where available) may be provided as an Information Document, but RailCorp will be under no obligation to provide such additional data.

In addition to the above, variations exist, and in many instances where low operation speeds are common, particularly in stabling roads, the track variations may be extreme and may remain at these conditions for extended periods of time.

A general requirement for the Sets is the compliance with track parameters as described in C2009, C2010 and C2011.

##### 4.2.1.3 Track Forces

PPP Co shall use all reasonable endeavours to ensure that the Sets do not exceed the track force limits specified in RSU 120. The track forces shall not exceed those exerted by the Millennium trains.

#### 4.2.2 Other Rail Construction Information

The track work includes a range of points, single and double slips and diamond crossings.

Blunt faced checkrails exist at crossings, turnouts and level crossings. The design maximum height of the checkrail above the running (stock) rail is 38 mm. The minimum design clearance between the checkrail and the running rail is 41 mm. Another type of check rail with a minimum design clearance of 41 mm mounted between the running rails of the track is used on bridges to guide a derailed train parallel with the rails and this reduces the risk of the train striking or escaping the bridge structure.

Housed points exist at some turnouts. Bolted joints exist between some lengths of rails. Tapered expansion joints are used on various bridges.

#### 4.2.3 Superelevation Deficiencies

RFTA  
00136

The maximum design Superelevation of the track is 140 mm, ~~which may be exceeded in places.~~ Superelevation is applied through transitions at a nominal maximum design rate of 1 in 500 but in exceptional cases this may reduce to 1:300. Variations in Superelevation can result in local twists greater than this.

Turnouts in some locations are in curves or curve transitions, and depending on the track design, may have no Superelevation applied (positive or negative). Superelevation may be applied to the main running line.

The Set shall achieve the specified ride characteristics at track Superelevation deficiencies up to 110 mm and shall be capable of safe operation on the rail network tracks at Superelevation deficiencies of up to 175 mm. Safe operation shall be deemed to be that the Set is not susceptible to derailment where the dynamic L/V ratio does not exceed the instantaneous value of 0.8 for periods of 0.05 sec or greater.

The Set shall be designed to operate to XPT speedboards up to a maximum speed of 130km/h. This will entail operation at design deficiencies in Superelevation up to 110 mm and require brake performance to levels as detailed in clause 10.1.3 (Deceleration) of this RailCorp Train Performance Specification.

#### 4.2.4 Track Curvature

The following track curvatures are the minimum radius limits (although minor local variations may occur) that may be found throughout the operating system, which does not include turnouts or crossovers. The following track curvatures are defined between flat and/or tangent and:

- a) 90 m horizontal simple curve;
- b) 160 m horizontal reverse curve;
- c) 600 m vertical concave or convex curve at speeds not exceeding 25 km/h; and
- d) 1000 m vertical concave or convex curves at speeds above 25 km/h.

Some horizontal curves are designed without transitions. Variations in the top alignment can result in the effective vertical curvature of much smaller radii over short distances.

Indicative track curvatures for the majority of the system are shown in the Curve and Gradient Diagrams book.

Notwithstanding the above, the requirements of the relevant RSU shall apply.

#### 4.2.5 Track Grades

The Set shall operate over track having continuous grades up to 1:30 and with some sections of track having short duration grades of 1:25 over lengths up to 100 m. Indicative track grades for the majority of the system are shown in the Curve and Gradient Diagrams book. The Set shall also be capable of operating over additional routes that are being planned, including the Parramatta Rail Link, consisting initially of the Epping to Chatswood alignment. A future re-alignment between Mt Kuringai and Hawkesbury River is also being planned. These new alignments will include similar grades to existing but they will be significantly longer and predominantly underground e.g. Chatswood-Epping grades of 1:35 for 4 km, and Hawkesbury River- Mt Kuringai grades of approximately 1:60 for 16 km. Details of the proposed Chatswood-Epping alignments are provided as an adjunct to the Curve and Gradient Diagrams book.

---

### **4.3 Power Source**

The Set shall draw power from the existing RailCorp Overhead Wire (OHW) network, in accordance with RailCorp's Specification FE 119 and RSU Appendix E.

The Set shall be capable of operating under the full range of Normal and Degraded performance requirements without exceeding the limits on line current, line voltage and parameters as specified in FE117 and RSU Appendix E relating to the OHW supply.

### **4.4 Stations and Platforms**

The stations on the Sydney Metropolitan Network have two nominal platform heights, 1065 mm and 1200 mm.

### **4.5 Rolling Stock Outline**

The Set shall meet the requirements of RSU 110 for "Medium Electric" Rolling Stock Outline.

PPP Co shall perform tests to demonstrate that the Set remains within the Static Rolling Stock Outline and Kinematic Rolling Stock Outline under all operating conditions of loading, dynamic behaviour and allowable wear, when tested at the Superelevation deficiency requirements nominated in RSU 289 and at Superelevation deficiencies as stated in clause 6.4.14 - Ride of this RailCorp Train Performance Specification.

### **4.6 Signalling**

#### **4.6.1 Compatibility**

The Sets shall be compatible with the RailCorp signal and communication systems used by RailCorp and shall be compatible with Specification SC 00 18 00 00 SP – Rolling Stock Signalling Interface Requirements under all Normal and Degraded operating conditions, with the exception of Section 5 which requires: "At least one axle per unit to be provided with the means to keep contact surfaces clear of any contaminant build up, especially while rolling on straight track". The braking performance shall meet the requirements of a high speed passenger train as set out in RSU 160.

### **4.7 Emergency Equipment and Maintenance Facilities**

The Sets shall comply with all current RailCorp policies and procedures for dealing with emergencies and shall be able to interface with existing equipment used in these operations. The Sets shall be compatible with existing CityRail emergency equipment. The Sets shall include equipment for dealing with emergency events as shown in Appendix U – Train Emergency Equipment.

### **4.8 Washplant**

The Sets shall be able to be driven through under their own power and washed without any detrimental effect in RailCorp's existing washplants as referenced in Appendix B – Washplant Facilities.

## 5 Operational Characteristics

The Sets shall be capable of use on both short stop services with frequent stops, starts and door operation and longer distance services at higher speeds on the Sydney Metropolitan Network and shall be capable of performing runs in accordance with those set out in Appendix C - Routes and Timings with up to 25% of traction cut out.

The Sets shall be able to achieve the operational requirements stipulated regardless of Passenger load or any other variable parameter such as wheel diameter for a period of twenty-four hours continuous operation per day.

The Passenger and Crew environments within the Set shall meet CityRail and Occupational Health and Safety requirements.

All of the interior and exterior of the Car and the access paths shall be compliant with the Australian Disability Standards for Accessible Public Transport 2002 and Amendment 2004 No.1 and No.2 (DSAPT) and any changes that are determined or published as outcomes by the Human Rights and Equal Opportunities Commission in a manner consistent with the requirements set out in Appendix J – DDA Requirements.

The Set's Design Life shall be thirty-five years.

### 5.1 Performance

PPP Co shall ensure the Sets supplied shall have good sustained low speed acceleration as defined in this specification and are capable of a network service speed of up to 130 km/h under all operating conditions. The performance shall be maintained under all loading conditions as shown in Table 4 below:

Description	Load case	Passenger Load
Tare Load – Empty New Set prepared for operation.	AW0	Nil
Seated Load – AW0 plus full seated load of Passengers; Driver and Guard	AW1	Fully seated Load
Peak Load – AW1 plus peak load of standees	AW2	Seated Load plus standees @ 2.5 Passenger per m <sup>2</sup>
Crush Load – AW1 plus crush load of standees	AW3	Seated Load plus standees @ 6 Passenger per m <sup>2</sup>

**Table 4: Loading Conditions**

### 5.2 Energy Consumption

#### 5.2.1 Energy Consumption Prediction

The Predicted Energy Consumption of the Sets running over the routes identified in Appendix C – Routes and Timings is as set out below in Table 5:

Route	Energy drawn from overhead supply	Braking Energy returned to overhead supply	Energy used in Auxiliaries (excluding HVAC)	Energy Used in HVAC	Total Energy Consumed
Hornsby – Central – Strathfield – Hornsby	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].
Hornsby –Strathfield – Central – Hornsby	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].
Bondi Junction – Waterfall	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].
Waterfall –Bondi Junction	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].	[Proponent to specify].

**Table 5: Predicted Energy Consumption**

A Set shall not draw more than 3600 A at 1450 V.

PPP Co shall develop the Predicted Energy Consumption by simulation of the proposed design and shall also highlight elements of the design that provide significant benefits in energy conservation to the operator over the life of the Cars to RailCorp. The Actual Energy Consumption of a Set shall be determined and demonstrated by PPP Co using a combination of simulation and testing of a complete Set on the network based on the assumptions in a) to g) below. The process for the testing shall be developed by PPP Co in accordance with the requirements for testing included in the CMR and accepted by RailCorp. The methods used for any elements of the demonstration that require simulation shall be agreed with RailCorp.

Details of the maximum energy consumed on a time based and on a distance based average consumption shall be provided at all stages of design development. These values shall be based on the following assumptions:

- (a) External ambient temperature of 30 degrees Celsius;
- (b) Full incident sunlight for 1500hrs (3.00 pm) Sydney time on 21 December at start of run;
- (c) AW3 loaded train and train doors opening consistent with dwell times in Appendix C – Routes and Timings;
- (d) 50% electrical auxiliary power supply load;
- (e) OHW line characteristics during regenerative braking with:
  - i) one set of simulations that assume OHW line voltage during regenerative braking of 1650 Volts; and
  - ii) a second set of simulations that assume OHW line voltage during regenerative braking of 1550 Volts;
- (f) 1450 Volts when powering; and
- (g) For the purposes of energy recovery during dynamic braking the line shall be considered to have an average receptivity of 20%.

**5.2.2 Monitoring of Energy Use**

The Set shall have facilities to monitor, record and download the net energy consumption. This consumption shall be divided into the following:

- a) traction;
- b) regenerated power returned to OHW;
- c) HVAC; and
- d) auxiliaries.

The energy consumption information shall be available on the Set and it shall be possible to extract soft copy information on the energy used in any stated time period or between any two location points provided that the time period requested is within the Event Recorder data storage period.

**5.3 Security**

The Set shall provide three levels of locked security access and shall allow access to equipment as summarised in Table 6 below:

Security Level	Access provided for	Accessible Equipment
Access 1 Security	Presentation Staff	<ul style="list-style-type: none"> <li>• GPO</li> <li>• Local Passenger Bodyside Door Controls</li> <li>• Fire Extinguisher</li> <li>• Crew Cab</li> </ul>
Access 2 Security	Crew	<ul style="list-style-type: none"> <li>• Maintenance Covers</li> <li>• Circuit Breakers in Passenger Accessible Areas</li> <li>• Park Brake on Non-Cab Cars</li> <li>• Pantograph Control Cupboard</li> <li>• Guard’s and Drivers Equipment including Train Operating System</li> <li>• Safety Equipment Locker</li> <li>• Local Door Isolation Controls</li> <li>• Intercar Doors Lock-open Function</li> <li>• Wheelchair ramp locker</li> </ul>
Access 3 Security	RailCorp and PPP Co Engineers and Maintenance Staff	<ul style="list-style-type: none"> <li>• Access to high voltage equipment</li> <li>• WSP Circuit Breaker</li> <li>• Brake System and WSP Self-test and Self-diagnosis</li> <li>• TOS storage of Maintenance Information</li> <li>• Event Recorder System Information and Download</li> <li>• CCTV Download</li> <li>• Commercial Radio: automatic interrupt time-out adjustments</li> </ul>

**Table 6: Access levels and accessible equipment**

An Access 1 Security key shall operate Access 1 Security only. An Access 2 Security key shall operate Access 1 Security and Access 2 Security only. An Access 3 Security key shall operate Access 1 Security, Access 2 Security and Access 3 Security.

5.3.1 Locks

All Access 1 Security, Access 2 Security and Access 3 Security locks shall be compatible with a Clift Engineering of Oberon (NSW) Bi-Lock 106 NR B or Lowe and Fletcher "Tangara" keys, or equivalent, and utilise RailCorp's issued keys. The Set locks keys and supporting control and reporting systems shall be of

RFTA  
00130



~~a period authorisation type. Key authorisation shall be performed periodically at stationary data network access points external to the Sets. Unless reauthorised, keys shall cease to operate Set locks.~~

~~The electronic locks shall be fitted to doors and covers giving access into Crew Cabs, namely:~~

- a) Crew Cab bodyside doors;
- b) Crew Cab transverse doors;
- c) terminal end emergency access doors; and
- d) covers giving access to Crew Cab bodyside door external EDRs.

~~All other Access 1 Security, Access 2 Security and Access 3 Security locks shall be compatible with a Clift Engineering of Oberon (NSW) Bi Lock 106 NR B or Lowe and Fletcher "Tangara" keys, or equivalent, and utilise RailCorp's existing issued keys.~~

~~PPP Co shall supply and install one authorisation station for its own use, connected to the RailCorp central server via the RailCorp intranet in order to demonstrate that the system meets the requirements of the Specification.~~

~~5.3.1.1 Control and Reporting Functions~~

~~RailCorp will control the access rights and authorities for the authorisation and reauthorisation of keys, using the central server.~~

~~PPP Co shall undertake the authorisation and reauthorisation of keys used by PPP Co staff requiring access to the Sets.~~

~~5.3.1.2 Keys and Authorisation Stations~~

~~The locks shall be used for Access 1 Security, Access 2 Security and Access 3 Security levels. Keys shall be supplied for all PPP Co staff requiring access to the Sets, together with a further two keys per Set for use by RailCorp staff requiring access to the Sets. The number, location and performance of authorisation stations, programming of key validity and lock/key validation times shall be such as not to impede normal RailCorp staff work flows.~~

~~In order to permit the future installation of a smart card access system (as described in clause 5.3.2 below), the locking function of all Crew Cab external EDR sealing devices shall allow for the future fitment of electrical latching lock mechanisms electronically activated locks shall be separate from the operating function of the associated door or cover.~~

~~a) Record access attempts~~

~~The authorisation server shall record not less than 99.9% of access attempts, whether valid or not and irrespective of whether keys used for invalid access attempts are returned to an authorisation station.~~

~~b) Period validation~~

~~Authorisation for any applicable lock stored in a key shall be configurable for a period of between 1 minute and 1 month, with the capability of being limited to specific days of the week and/or specific times of the day, during the validity period.~~

~~c) Audible alarm on unauthorised access attempts.~~

~~An audible alarm (minimum 50 db(A)) shall sound when a key is used in an unauthorised lock. This is intended primarily as a warning to the key user, but also to alert nearby RailCorp staff.~~

~~d) Key battery life~~

RFTA  
00130

~~Replaceable key batteries shall have sufficient energy and longevity so as to require replacement at a frequency of not greater than once per year.~~

~~e) Physical constraint~~

The barrel of any lock shall not protrude from the surface of the equipment or door by more than 6 mm.

5.3.2 Smart Card Access - Future Provision

Provision shall be made to permit the later conversion of the Set to use a smart card-based access system with minimum cost and downtime.

Smart card access will be required for all locks giving access into Crew Cabs, as described in clause 5.3.1. The smart card access system shall allow access and record the identity of staff accessing the Set.

All necessary equipment space allocations shall be provided to allow the Set to be converted readily to smart card access by the addition of appropriate equipment. Such equipment will include:

- a) Smart card readers/controllers for each lock concerned;
- b) Additional cabling to provide the interface between the smart card access system and other on-board systems;
- c) On-board databases;
- d) Enhanced TOS functionality to integrate with other on-board systems; and
- e) Datalink to provide connectivity with ground-based systems.

RFTA  
00130

f) Space allocation and conduits for an electrically operated locking mechanism on the crew bodyside doors, the crew transverse door and the terminal end door external EDRs in each Crew Cab.

The addition of the extra equipment for smart card access systems shall not require the addition of enclosures, conduits, junction boxes or other attachments, but may require penetration of the body skin for the installation of the card readers and datalink.

RFTA  
00130

When required in order to demonstrate that the system meets the requirements of the Specification, PPP Co shall supply and install one authorisation station for its own use, connected to the RailCorp central server via the RailCorp intranet.

5.3.2.1 Control and Reporting Functions

RailCorp will control the access rights and authorities for the authorisation and reauthorisation of cards, using the central server.

PPP Co shall undertake the authorisation and reauthorisation of cards used by PPP Co staff requiring access to the Sets.

5.3.2.2 Access

a) Record access attempts

The authorisation server shall record not less than 99.9% of access attempts, whether valid or not and irrespective of whether cards for invalid access attempts are returned to an authorisation station.

b) Period validation

Authorisation for any applicable lock stored in a card shall be configurable for a period of between 1 minute and 1 month, with the capability of being limited to specific days of the week and/or specific times of the day, during the validity period.

c) Audible alarm on unauthorised access attempts.

An audible alarm (minimum 50 db(A)) shall sound when a card is used in an unauthorised lock. This is intended primarily as a warning to the card user, but also to alert nearby RailCorp staff.

5.3.3 Train Security

When Stabled the Sets shall be secured by ensuring that all the external doors are closed and locked, without the need for Crew to walk through or around the Set. Advice (both aural and visual) of any door not closed and locked shall be provided to the Crew prior to the Set entering the Stabled state.

**5.4 Operational States**

The Set shall have the following states:

- a) Presentation;
- b) Stabled;
- c) Normal; and
- d) Nightsafe.

5.4.1 Presentation

The Set shall only be switched into Presentation from the Stabled or Normal states or from the emergency condition.

To switch the Set into Presentation a cleaner's key shall be inserted ~~operated~~ in the ON position in any Cab when no crew cab is active.

The cleaner's key switch shall be located in the crew cab and it shall be an Access Level 1 three position switch sprung to return to a central vertical position with momentary positions ON and OFF.

In Presentation the pantographs are raised automatically to provide power to other systems, Emergency Door Release controls are enabled, all internal CCTV cameras, external CCTV cameras, including the end of Set cameras are enabled and images recorded, air conditioning is turned on, the Passenger compartment and Cab lights are turned on and local door controls are enabled. 240V AC is available at the GPOs in the saloons and the crew cab in Presentation state.

Upon selecting Presentation state, this state will continue for a minimum of two (2) hours duration, unless either a crew key is operated or if Presentation state is cancelled. Presentation state can be cancelled by switching the cleaner's key to the OFF position in any cab when there are no active cabs. In this case the Set shall enter the Stabled state. Following the elapse of the two (2) hours Presentation state time period, the Set shall enter the Stabled state. If a crew key is operated whilst the Set is in Presentation state, the Set shall enter the Normal state and Presentation state shall be cancelled.

~~The Set shall only return to the Stabled state from Presentation.~~

5.4.2 Stabled

The Set shall only be switched to Stabled from Presentation or Normal States.

~~To switch to Stabled from Presentation the cleaner's key shall be removed.~~

The Set can be switched to Stabled from Presentation by the following methods:

- Cleaner's key operated in the OFF position in any crew cab with no crew keys operated.
- Following the elapse of the two(2) hour Presentation state time period with no crew keys operated.

RFTA  
00354

RFTA  
00075

To switch to Stabled from Normal all ~~control keys~~ Driver's and Guard's keys shall be removed and the Stable Push Button shall be pressed.

To switch to Stabled from emergency condition, all Driver's and Guard's keys shall be removed and the Stable Push Button shall be pressed, or when the control batteries have depleted to the point of low battery cutoff.

Information regarding the commencement of a stabling sequence shall be made available via the Set-borne Gateway. If any stored data retrieval transactions, or data update transactions are in progress 30 seconds after the commencement of stabling then the stabling sequence shall be delayed until the transactions are complete, up to a maximum of 60 minutes delay.

In Stabled the pantographs shall be down, parking brakes shall be applied, all external doors shall be closed and locked, all external and internal Passenger bodyside door Emergency Door Releases shall be rendered inactive and all Set systems shall be inactive except for:

- a) Clocks within equipment;
- b) Train Marker Lights;
- c) Crew Cab door control; and
- d) Crew Cab interior lighting controls.
- e) Internal Passenger bodyside door EDRs (unless made inactive through configurable maintenance task as defined in Clause 6.7.2.3.1)

After switching the Set into the Stabled state (~~except in the case of low battery cutoff~~), a time delay of approximately 20 minutes is required during which the external step lights shall remain illuminated to allow for Crew to walk alongside of the Set in dark conditions and ~~adequate internal lighting~~ Emergency Passenger Stage 2 lights and Crew cab lights shall remain illuminated to enable a Driver or Guard to self-evacuate from a Set.

From Stabled the Set shall be switchable to only Presentation or Normal states.

#### 5.4.3 Normal

The Set shall only be switched into the Normal state from Stabled, Presentation, emergency condition or, for individual Cars, from Nightsafe.

A Driver or Guard can switch the Set from Stabled state to Normal. Once Driver or Guard has operated their key the Driver or Guard can operate the Pantograph Raise pushbutton to raise all pantographs on the Set.

To switch to Normal from Stabled either a Driver's key, ~~or a Guard's key or both shall be inserted~~ or any combination of these keys shall be operated in the ON position.

To switch to Normal from Presentation either a Driver's key or a Guard's key or any combination of these keys shall be operated in the ON position. Switching to Normal shall cancel Presentation state.

~~Once the Set is switched to Normal, first key is inserted when selected by the Crew~~ the Set shall commence a start up and test routine. This routine shall be referred to as Train Preparation.

Train Preparation shall prepare the Set for service and shall in conjunction with the Driver and the Guard, include a self-test of all Set-borne equipment to confirm that the equipment is in a condition that meets or exceeds the Minimum Standard (OMET200) for the Set.

As part of Train Preparation the TOS shall be powered up and the Driver and Guard prompted to input their personal codes into the TOS.

Once logged in, the TOS shall provide prompts to the Crew to complete Train Preparation. Any input from the train Crew shall be minimised and shall be only to confirm that systems, which cannot be fully self-tested are functional. There shall be no requirement for Crew members to walk down the side of the Set to complete normal Train Preparation. On completion of Train Preparation the Set shall provide a status report on the Set. This report shall be available at any time the Set is in Normal. PPP Co shall provide

RFTA  
00075

facilities to minimise the need for Crew members to walk along the side of the Set to effect isolations and carry out checks to make a Set that fails the normal preparation routine meet the Minimum Standards.

The time for Train Preparation shall be kept to a minimum and the self-check functions performed by the Set and any charge up times for compressed air or other train features shall not exceed 9 minutes. This includes the air suspension which shall be fully charged (if fitted). The preparation routine shall be developed in conjunction with RailCorp and shall include scenarios for a Driver preparation, a Guard preparation and a joint preparation.

When in Normal state it will be necessary to change Crews or for Crew members to change Cabs. During this changeover activity, the Set shall remain in the same state, including any Cars set into Nightsafe, the state of the Passenger and Crew doors, HVAC, lighting, brakes, traction and other systems. Excluding any time taken to enter, leave or move between Cabs, the Set shall permit Crew changeover to be completed in no longer than 20 seconds, including a 5 second allowance for the arriving Crew member to enter his/her identification code where this may be required.

The Set shall return to Stabled once all Set keys are removed and the Stabled Push Button is pressed.

#### 5.4.4 Nightsafe

When the Set is in Normal it shall be possible for one or more Cars to be suspended from service operation into the state defined as Nightsafe.

The Cars shall be switched into and out of Nightsafe from any active Driver or Guard Station and from the Set exterior at both platform and trackside levels. It shall also be possible to switch a Car out of Nightsafe by the operation of an intercar EDR as described in Clause 6.7.2.3. The external control switch shall be a three-position switch sprung to return to a central vertical position. Movement of the switch to either side of central shall switch the Car between Normal and Nightsafe states. The exterior control switch shall be secured by an Access 2 Security lock.

When a Car is in Nightsafe state the lighting and HVAC in the Passenger areas shall be turned off. The lighting and HVAC in any Cab in that Car shall remain operational. Bodyside external doors shall be closed and locked as shall any intercar access doors that lead into the Car that is placed into Nightsafe mode.

Intercar doors leading out of a Nightsafe Car into any other Car shall remain operable as shall all train-borne communications equipment on Cars in Nightsafe mode. Additionally the PEI units shall be illuminated and operational.

If a Car is in Nightsafe when the Set is switched to Stabled then it shall Stable. When the Set is then moved to another state all Cars in the Set shall adopt that state.

RFTA  
00022

## 6 Carriage Body Configuration

### 6.1 Materials

RailCorp’s preferred material of construction for the Set bodysides and roof is stainless steel and for the underframe high strength steel suitably protected against corrosion. This is because of their performance in relation to;

- a) Corrosion resistance;
- b) Crashworthiness, due to its larger deformation before fracture when compared with other materials such as aluminium;
- c) Graffiti removal;
- d) Resistance to chemical attack;
- e) Aesthetic qualities;
- f) Low maintenance requirements (including no need to repaint regularly); and
- g) Predictable fatigue behaviour.

PPP Co may offer alternative materials for the Car body but the reasons for selection of these alternative materials shall be detailed and a comparative safety assessment shall be undertaken. PPP Co shall conduct a safety assessment to justify the grades of any selected materials.

### 6.2 Body

For a Set the overall length shall be not greater than 163.1 m nor less than 162 m over coupling faces and be compliant with specification C2108.

RFTA 00058 <u>RFTA</u> <u>00227</u> <u>RFTA</u> <u>00322</u>	6.2.1 Mass
---	------------

RailCorp’s preference is for the overall tare mass of a Set in new condition and ready for operational service to be not greater than ~~395.5688~~ tonnes. RailCorp’s preference is for a lightweight energy efficient design.

RFTA 00010	6.2.2 Width
---------------	-------------

The Car interior space shall be maximised with a Car interior width measured across the full width of the Car, of at least ~~2916 mm on the upper Saloon and at least 2930 mm on the lower Saloon~~ 2920 mm. The above measurements shall be taken at the shoulder height of the seated Passengers.

The width over the open doors with plug doors out of plug shall meet the requirement set out for Medium Electric Rolling Stock in RSU 110.

#### 6.2.3 Height

The Car body height shall be in compliance with Figure 8 in RSU 110.

The internal head height shall be maximised within the vehicle profile, and shall be a minimum of 1920 mm for walking and standing Passengers in the Passenger areas. The internal ceiling profile of the upper and lower Saloons shall be similar to the profile shown in Appendix W - Millennium train internal Passenger Compartment. The internal profile of the single deck sections of the Cars shall maximise clear heights within the constraints of gauging and equipment requirements.

#### 6.2.4 Passenger Door Locations

The centre distance of the Passenger doors shall be as defined in Appendix D – Door Positions and Axle Numbers.

The Set shall minimise the gap between Set doorways and platform.

6.2.5 Passenger Capacity and Compliance

The Set Passenger capacity shall be maximised within the design constraints of this RailCorp Train Performance Specification.

6.2.6 Interior Design

RFTA  
00011

The ~~Exterior and interior design optimisation study design~~ shall consider ~~eliminate~~ any hidden spaces, gaps, recesses and voids that provide opportunity to conceal suspicious items.

The Set interior design shall be designed to minimise the risk of injury to Passengers in normal operation and under collision, derailment or other accident scenarios.

6.2.7 Passenger Flow

Each Set shall have a 95% probability of loading, or unloading an AW3 able bodied loaded Set at a platform within an eighty-second period.

6.2.8 Passenger Seats

RFTA  
00248

All Passenger seats unless otherwise specified, shall meet the requirements of RailCorp's Specification FE 038, for Sections 2.0 - General Description, 4.0 - 4.3 Structural Design Data and Test Procedure (amendments to include; references to vinyl to be deleted, and clause 4.1(h) An impact simulating two 95th percentile adult males being thrown simultaneously into the seat back with a velocity of 2.5m/s without permanent deformation and with a velocity of 3.0m/s without ultimate failure, clause 4.1(i) the seats shall be tested to 75,000 cycles, and reference to R589 shall be replaced with FE 103), 5.0 Seat Squabs, 9.0 - Security of Seat Squab and Base, 12.0 Cleaning, 13.0 Removal of Graffiti and Appendix 1. Seat comfort testing shall be conducted in conjunction with RailCorp. PPP Co shall engage an independent expert in seat design to carry out the testing as detailed in FE038 Appendix 1, at no additional cost to RailCorp. The standard seat for comparison shall be the Millennium train seat.

PPP Co shall develop an optimum seat design using a trade-off study which shall be submitted for Technical Review as part of the Design Documentation.

The Set shall include reversible seating in the Passenger Saloon areas. The reversible seat back mechanism shall ~~prevent control~~ movement of the seat back to contain Passengers when subject to an impulsive force such as would be experienced ~~in a collision by the seats in the collision performance conditions as defined in Clause 6.8 of this Train Performance Specification~~, but allow the seat back position to be changed easily by Passengers when required. The reversible mechanisms and operation shall minimise finger or rubbish entrapment.

RFTA  
00170

The seat design and layout shall maximise the available legroom for seated passengers. The seating shall use individual Passenger position seat squabs and backs.

Armrests shall be fitted to the aisle side of all transverse Passenger seats. Passenger grab handles shall be fitted between individual backrests and on the backrest of the aisle side of all transverse Passenger seats to aid the movement of Passengers. There shall be no seating in the doorway Vestibule areas.

- a) All Passenger seats shall have a backrest of sufficient height to contain Passengers in the ~~event of a collision at speeds of up to 55 km/h~~ collision performance conditions as defined in Clause 6.8 of this Train Performance Specification. The backrest height shall be maximised, taking into account other key design parameters including ease of access to and egress from seats, CCTV coverage, and quantity of seats, but shall not exceed a height adequate to provide support for up to the 95th percentile male Passenger. The allocated seat width per Passenger at seat level shall be at least 445 mm, not including armrests. Greater seat widths are preferred.
- b) The spacing between seats facing in the same direction shall allow for a minimum dimension of ~~750~~ 700 mm between the back of the front walkover seat to the front of the backrest of rear walkover seat. The spacing between fixed seats and the back of the adjacent walkover seat facing in the same direction shall allow for a minimum dimension of 670 mm. The measurement shall be taken at 100 mm above the highest point front of the rear seat squab and parallel to the floor.

- c) The design of seat and their positions in the Car shall minimise the risk of retention of objects and the risk of injury to Passengers as they sit or move across a seat. The space underneath the seats shall be clearly visible.
- d) Seat coverings or underlay, when undamaged, shall prevent the transmission of liquids to the materials inside or beneath them, including the seat cushions. The coverings of Passenger seats shall provide a trade off between appearance, cleanability, Vandal resistance, repairability and longevity. Seat covers shall be removable to allow for cleaning or quick replacement. Seat cover material shall be moquette. PPP Co shall provide suggestions during the Mock-up stage.
- e) Where equipment is mounted under Passenger seats the area shall be sealed to prevent the ingress of water to at least ~~AS 1939~~ AS 60529 IP56.
- f) The materials selected should not become readily soiled and shall be easily cleaned and impervious and chemically unaffected by water, paint, human waste, Graffiti removers, washplant solutions, cleaning solutions, food and drink spills.
- g) The materials selected shall resist Vandalism and increase the effort required to damage, vandalise, deface and allow rapid remediation.
- h) Passenger seating shall be arranged laterally in groups of 3 persons plus 2 persons per row in the Saloon area. Where space permits, single seats shall be provided to maximise seating capacity.
- i) The unobstructed aisle width in the transverse seating Saloons shall be at least 450 mm, with a preference for 470 mm. Wider aisle widths are preferred.
- j) All Saloon seats shall be aligned with the body windows to provide a clear view to the Car exterior for all seated Passengers. Bodyside pillars shall be positioned to minimise obstruction to Passenger viewing.
- k) Except behind a Crew Cab, each End Saloon area of all Cars, shall have at least eight Passenger seats provided. ~~Not less than two~~ At least one Passenger seats shall be provided behind a Crew Cab.
- l) Except behind a Crew Cab, all End Saloon area Passenger seating shall be arranged Longitudinally and shall provide a minimum of 480 mm width when measured at the seated Passenger shoulder height. Behind a Crew Cab, the End Saloon area Passenger seating shall be arranged Longitudinally and shall provide a minimum of 450mm width when measured at the seated Passenger shoulder height. The seat squabs and backs shall be contoured, consistent with the other requirements.
- m) At allocated Wheelchair Spaces flip up seats shall be provided, they shall be of minimum thickness when raised so as to provide allocated spaces and access paths, and be of the same level of comfort as the other End Saloon seating. Flip up seats over an allocated Wheelchair Space shall be joined so that they can be raised/lowered together in one movement. The force required to raise or lower a flip up seat shall not exceed 50N. Flip up seats shall be designed to prevent finger entrapment during operation and stay in the last position used.
- n) Flip up seats adjacent to the end wall in an allocated Wheelchair Space shall be flush with the wall with no filler required when in the lowered position.
- o) The End Saloon seat and window heights shall allow for clear visibility to the exterior of the Car for seated Passengers.
- p) Space shall be provided for wheelchair Passengers. This space is preferred to be at the Car ends with the wheelchair users seated in a Longitudinal direction with a view towards the bodyside Passenger doors. No Wheelchair Spaces shall be located in the End Saloons adjacent to Crew/Guard cabs.
- q) The seat design shall limit the accumulation of rubbish.
- r) All seat covers, patterns and colours shall be in compliance with RailCorp's CityRail branding.
- s) Priority Seating shall be fixed and located in close proximity to the Wheelchair Spaces. Seat covers should be the same style but different colour to other fixed/flip up seats.

RFTA  
00253

RFTA  
00367

Letter  
RC00273



6.2.9 Not used

6.2.10 Flooring

RFTA  
00283

The floors and steps in all Passenger and Crew areas shall be supplied with slip resistive surfaces, having a coefficient of friction equal to or greater than ~~0.5~~ 0.42 for wet conditions and 0.7 for dry conditions when tested to AS/NZS 4586. The floor covering shall maintain this performance level throughout its life. The materials selected shall resist Vandalism and increase the effort required to damage vandalise, or deface and shall allow rapid remediation in situ.

The floor covering shall have as few seams as possible, all seams shall be fully sealed and welded and shall not create a tripping hazard. Seamless flooring is preferred.

The floor covering pattern and colours are to be identical with those used in respect of the Millennium trains.

RailCorp anticipates that meeting the required fire performance, slip resistance, wear resistance and cleanability requirements of the Contract will require a high grade material.

RFTA  
00312

*6.2.10.1 Flooring Performance Requirements*

All floors and steps, ~~including coverings~~ shall withstand a force of 1000 N and all floor coverings shall withstand a force of 294N applied over an area of 25mm<sup>2</sup> without suffering permanent deformation or damage and meet the requirements as detailed in RailCorp specification FE087 sections 2.11, 2.14, 2.15, 2.16 and 2.17. Where flooring materials other than plywood are proposed, alternative test specifications shall be submitted for review and acceptance by RailCorp.

RFTA  
00252

*6.2.10.2 Floor to Wall Interface*

RFTA  
00120

All wall surfaces shall be colour contrasted to the floor surfaces and handrails. All Saloon floor to wall interfaces shall have a nominal radius of 50 mm, except in the saloon lower deck where the side wall to floor interface shall be a nominal radius of 250mm, and in the saloon upper deck where the side wall to floor interface shall be a nominal radius of 100mm. ~~and~~ The floor covering shall continue up the walls for at least 150 mm, except in the saloon upper deck where it shall continue up the walls for 100mm or to the seat rail.

*6.2.10.3 Permeability*

All floor covering material and joins shall be impervious and chemically unaffected by water, paint, human waste, Graffiti removers, washplant solutions, cleaning solutions, food and drink spills.

*6.2.10.4 Removability*

The floor design shall allow the floor covering to be removed and replaced with out damage to the floor sub structure.

*6.2.10.5 Raised Floor*

The floor of the Cab shall be sloped towards the Saloon to prevent the ingress of any liquid spills. A small step may be placed across the transverse door threshold to assist in meeting the sound attenuation property of the door however this step shall not impede access of any person through the door.

*6.2.10.6 Visibility of Hazards*

The flooring adjacent to stairs, doors and other potential hazards shall be highlighted visually to alert both sighted and visually impaired Passengers of the hazard.

6.2.11 Handrails

Internal handrails shall be fitted in combination with all steps. The design of all handrails shall be in accordance with DSAPT requirements, AS1428.2 or an equivalent international standard.

The handrails shall complement requirements for loading and unloading, assisting all Crew and Passengers including special user groups, and minimise the risk that Crew, Passengers or their belongings catch or become entrapped.

The layout and configuration of the handrails shall be such as to maximise the assistance and support provided to Crew and Passengers without impeding their movement in normal and emergency scenarios. The layout of the handrails shall be developed during the Mock-up stage. The use of part height free standing handrails is not preferred.

All internal handrails shall be the colour of AS2700 ASY15 “Sunflower” yellow and shall be highly resistant to acts of Vandalism including the etching or scratching of the surface.

RFTA  
00118

The whole Set exterior shall, wherever possible, be free from hand-holds that might aid a trespasser in climbing onto the Set. In areas where handholds cannot be eliminated, these are to be identified via a report forming part of the Design Documentation.

#### 6.2.11.1 Crew Handrails and Steps

Handrails and steps shall be provided which assist personnel entering or exiting the Cab from platform level, rail level and below rail level on both sides of the Car. As far as is practicable, steps shall be equally spaced and together with handholds be designed to maximise ease of entry. Steps shall have a colour contrasted, slip resistant nosing.

Handrails shall be provided on both sides of the Crew bodyside doorways inside the Crew Cab adjacent to the Crew bodyside door permitting the Crew, while standing, to hold on and view the exterior of the Set while the Set is moving.

#### 6.2.11.2 Vestibule and End Saloon Handrails

Handrails shall be provided in the Vestibule and End Saloon areas and shall be of a design that will not trap body parts.

Hanging hand-grabs shall be mounted in areas where handrails can not be mounted, such as allocated Wheelchair Spaces and shall not be strap loops.

#### 6.2.11.3 Handrail Accessibility

The handrails for assisting entry or exit to the Car shall be exposed and readily accessible to all Passengers, particularly the aged, infirmed or disabled, whenever the Passenger side doors are open. To assist the aged, infirmed or disabled the handrails on either side of the Passenger doors shall lead without interruption to the Saloon areas. Handrails shall be provided on each corner of the gangway interior.

#### 6.2.11.4 Applied Loads

All handrails shall withstand loads of at least 2200 N applied in any direction without detachment or permanent deformation.

#### 6.2.11.5 Obstruction

The location of handrails on or adjacent to access paths shall not obstruct wheelchair or scooter access, passing or manoeuvring from the entrance to designated Wheelchair Spaces and through intercar doors.

#### 6.2.12 Draughtscreens

RFTA  
00245

Draughtscreens shall be provided at each doorway entrance. The draughtscreen shall not impact upon visibility throughout the Car except the guard's side TDC No.2 End, and be recessed from the doorway by at least 200 mm except for single seats behind the Cab in TDC. They shall extend from below seat level to Car ceiling level. The panels shall be transparent except for single seat behind the Cab in TDC on the guard's side. They shall also extend from Car wall to the seat knee-edge, and shall protect seated Passengers against wind and rain. The panels shall provide a vertical grab rail at the edge closest to the centre of the Car.

In place of the draughtscreen on the guard's side at the TDC No.2 there shall be a panel housing the EDR, PEI and crew door controls normally housed in the standback area of the standard draughtscreen.

RFTA  
00322

Draughtscreens shall have 3M safety and security film specification type SH8CLARL applied to both surfaces, post installation of the draughtscreens into Cars. Film shall be applied to draughtscreens by 3M licensed installers only. Film shall be pre-cut to exact sizes by installers using Computer Numerically Controlled cutting techniques. Detailed trimming of film in-situ will not form part of the application process. Film application methods shall be designed to facilitate ease of future replacement.

6.2.13 Steps

6.2.13.1 Antiskid Treads

All internal and external steps shall be provided with an effective anti-skid tread surface providing a slip resistance with a coefficient of friction of at least 0.8 (internal and external dry conditions, and external wet conditions) or 0.65 (internal wet conditions) when tested to AS/NZS 4586. The nosing of the step shall be provided on the full trafficable width of the step and shall be colour contrasted.

6.2.13.2 Interior Steps

The interior step design shall be such as to maximise Passenger access to the upper and lower Saloons. PPP Co shall aim to achieve compliance with the requirements in the DSAPT for stairways and shall also aim to maximise seating and standing space.

6.2.13.3 Exterior Body Steps

RFTA  
00002

At all Crew and Emergency Door positions steps shall be provided, which assist persons entering or exiting the Car from platform level, rail level and (for the purposes solely of this clause) from up to 450 mm below rail level on both sides of the Car.

As far as is practicable, the exterior step rises shall be equally spaced. All exterior steps shall be located directly below the open doorway. Steps shall not curve inward toward the underside of the Set.

RFTA  
00289

All exterior body steps shall be a minimum of 400 mm wide. Any exterior body enclosed step pockets shall be a minimum 150 mm deep and 150 mm high to allow safe use, except for a 60x85mm chamfer at the back of the step pocket above the toe area for the crew cab door switch.

Provided that all other practicable alternatives have been eliminated RailCorp may approve a Variation application against the gauging requirements should this be necessary to achieve a safe and workable step design.

Two sets of steps shall be provided at each Emergency Door position although RailCorp reserves the right to delete one set should gauging issues render it not possible to design a suitable arrangement.

6.2.14 Loading

The proof load used in calculations shall be multiplied by a Proof Load Factor as required in clause 5 Load Factors of the UK Railway Group Standard GM/RT2100.

6.2.14.1 Compressive Longitudinal End Load

The Car body structure and attachments shall be designed to withstand a static compressive Longitudinal end load of 2.0 MN applied to the centreline of the coupler without permanent deformation.

The Car body structure and attachments shall be capable of withstanding a static compressive Longitudinal end load of 3.0 MN reacted through a combination of the anti-climbers and the centreline of the coupler without permanent deformation.

6.2.14.2 Tensile Longitudinal End Load

The Car body structure and attachments shall be designed to withstand a static tensile end load of 2.0 MN applied to the centreline of the coupler without permanent deformation.

6.2.14.3 Vertical Loads

The Car body structure and attachments shall be designed to withstand vertical loads consisting of

- a) weight of Car body (with all equipment fitted);
- b) Passenger AW3 load; and
- c) dynamic effects.

without permanent deformation.

#### 6.2.14.4 Combined Loads

The Car body structure and attachments shall be designed to withstand the above combined Longitudinal compressive end load and vertical loads without permanent deformation. The Car body structure and attachments shall be designed to withstand the above combined Longitudinal tensile end load and vertical loads without permanent deformation.

#### 6.2.14.5 Lifting Loads

The Car body structure and attachments (including bogies) shall be capable of being lifted at one end in the AW0 loading condition from the centre of either Headstock or coupler mounting without permanent deformation.

The Car body structure and attachments shall be capable of being lifted in the AW0 loading condition with bogies from lifting pads which shall be provided in the vicinity of the Car body Bolsters, without permanent deformation.

Both the above lifting loads shall be subject to the requirements of sections 13.3 and 13.4 of GM/RT 2100.

Lifting of the Car on a Car diagonal is not a requirement.

#### 6.2.14.6 Loads on Car Body Attachments

The Car body structure and all equipment attached (excluding the bogies) shall withstand a 5g Longitudinal, 2g Lateral and 2g vertical acceleration over and above gravitational acceleration acting on any bracket, fixing, partition, interior or exterior fitting or anchorage without permanent deformation.

The above components shall also be designed using a fatigue methodology that prevents fatigue Failure over the life of the Set.

The body-to-bogie attachments shall withstand the following loads without permanent deformation:

- a) Longitudinally the respective bogie mass subjected to a 5 g Longitudinal acceleration in either direction;
- b) Laterally the greater of half the body mass at AW3 loading or the respective complete bogie mass subjected to a 1.1g acceleration in either direction; and
- c) Vertically the greater of half the body mass at AW3 loading or the respective complete bogie mass subjected to 2g acceleration over and above gravitational acceleration in either direction.

#### 6.2.14.7 Loads on Car Body Coupler Pocket

The coupler assembly shall have a built in energy absorbing device.

The Car body coupler pocket structure including the coupler stops shall have sufficient strength to allow the energy absorbing device to be expended before any permanent deformation to the coupler pocket or surrounding equipment occurs. Note also crashworthiness requirements in clause 6.8 (crashworthiness) of this RailCorp Train Performance Specification.

The criteria for permanent deformation to the coupler pocket shall apply to Lateral and vertical coupler swing for instances when the coupler self-centring device (where fitted) is not working or is overloaded.

Where these criteria cannot be achieved the location of miscellaneous electrical and pneumatic equipment and the body design shall be such as to minimise the extent of damage due to coupler swing during

collision situations. ~~Where damage is caused by coupler swing during collisions of up to and including 15km/hr, PPP Co shall repair this damage at no cost to RailCorp.~~

#### 6.2.14.8 Loads on Car end structure, vertical end crash barrier columns and anti-climbers:

- a) Vertical end crash barrier columns shall withstand a static end load of 700 kN shared acting on the Car body on the "anti-telescoping" column(s) or otherwise 1650 mm above rail level and reacted at the coupler position at the other end, without permanent deformation.
- b) The anti-climber devices shall withstand a compressive load of 1.5 MN (equally shared) and reacted at the coupler position at the other end, without permanent deformation.
- c) The anti-climber faces shall withstand a combined load of 1.0 MN compressive and 100kN vertically (equally shared) and reacted at the coupler position at the other end, without permanent deformation. The Car shall be in the AW3 loaded condition.
- d) The anti-climber devices shall withstand a combined load of 100kN transversely and 100kN vertically (equally shared), without permanent deformation.
- e) The Car body structure and attachments shall be designed to withstand a static compressive load of 0.5 MN applied at diagonally opposite anti-climbers or structural members closest to the corners of the Car without permanent deformation.

#### 6.2.14.9 Additional Load Case Requirements

The Car body structure shall withstand the following proof loads, which shall be in combination with the Car body structure's own weight, and which shall be reacted at the other end in either the same manner and height or at the coupler position. The acceptance criteria apply to all parts of the Car structure.

- a) A Longitudinal compressive uniformly distributed force of 400 kN applied to the end of the Car at the higher of 350 mm above the coupler centre-line or 150mm above the top of the floor structure, without permanent deformation to the main Car structure.
- b) A Longitudinal compressive force of 300 kN applied to the end of the Car at any height from that given in a) to waist rail (or window sill), without causing permanent deformation. For a Car containing a Cab, the window sill(s) shall withstand this load distributed over the window sill length.
- c) A Longitudinal compressive uniformly distributed force of 300 kN applied to the end of the Car at Cant Rail height or at the horizontal load bearing member (the top of the windscreen at the TDC No 2 end or the header beam at all other ends) closest to Cant Rail height, without permanent deformation to the main Car structure.
- d) A Longitudinal compressive force of 150 kN applied to the body end at any point on each of the side wall edges between the Sole Bar (Side Sill) and Cant Rail heights, without permanent deformation to the main Car structure. Both side wall edges may be loaded simultaneously.
- e) A Longitudinal compressive force of 150 kN applied to any point on the full height collision column adjacent to the sides of the inter-car emergency exit door, between Sole Bar (Side Sill) and Cant Rail heights, without permanent deformation. Both columns may be loaded simultaneously. If only one column is provided adjacent to the emergency exit door, it shall be on the side closest to the Driver.

#### 6.2.15 Car Body Fatigue

The Car body shall not crack due to fatigue during its Design Life.

PPP Co shall provide a fatigue life evaluation of the Car body conducted with an industry-recognised methodology that has been successfully applied to railway vehicles of similar characteristics operating in a similar operational environment. The methodology shall generally follow that shown within Appendix E – FEA and Fatigue Life.

RFTA  
00043

## 6.2.16 Projectile Structural Resistance Design

The body and attached components shall protect Passengers and Crew against the risk of injury from projectiles as nominated below and shall be validated by test.

### 6.2.16.1 Side and Roof Areas

All side and roof areas, with the exception of the windows, shall withstand without any penetration into the Car interior an impact created by a sharp cornered hollow steel cube of 75 mm side and 1 kg mass, travelling corner first at a velocity of 80 km/h.

### 6.2.16.2 Roof Areas

The roof, including any windows which may form part of the roof, shall withstand an impact from falling objects such as a sharp-cornered concrete cube of mass 11 kg, dropped from a height of 10 m, corner first. No part of the falling object shall penetrate any part of the roof. Damage shall be limited to local roof deformation. Internal ceiling height shall be maintained after local roof deformation has occurred.

A location shall be provided on the roof of the Car where emergency services may cut through to gain access to the interior of a Car that has rolled onto its side. This space shall be clearly labelled to enable emergency services to immediately identify the appropriate space and cut lines. The location shall be adequate to enable a stretcher borne patient to be removed from the Set. The region to be cut shall be devoid of any cables/pipes or miscellaneous equipment that may impede access.

### 6.2.16.3 Forward Areas

All forward facing areas of leading and trailing Cars, including the ends of the lower Saloon section, with the exception of the Driver's windscreen, shall withstand without any penetration an end impact created by a sharp cornered hollow steel cube of 75 mm side and 1 kg mass, travelling corner first at a velocity of 160 km/h. The region of impact application shall be taken to be anywhere on the Car body forward facing area. The terminal end emergency access door and detrainment ramp in combination may be considered as a forward facing area.

RFTA  
00393

## 6.2.17 Car Body Natural Frequencies

Car body natural frequencies shall be determined under at least 3 load cases including AW0, 50% loaded and AW3 loaded conditions in order to separate frequencies of Car body and bogies to avoid resonance throughout the Operational Speed Range.

The Car body interior shall not produce vibrations in the frequency range for which the human body is susceptible.

## 6.2.18 Centre of Gravity and Roll Centre

PPP Co shall nominate and show by full analysis the location of the centre of gravity and roll centre of each Car type under AW0 and AW3 loaded conditions. The centre of Gravity of each Car shall be as low as reasonably practicable.

## 6.2.19 Internal Noise

Noise measurements at locations where Passengers can be seated shall be made at a height of 1.2 m Above Floor Level. Noise measurements at locations where Passengers can stand shall be made at a height of 1.6 m Above Floor Level. All Passenger area measurements shall be made with the Passenger area unoccupied, except for up to 3 testing personnel. A preliminary survey of noise levels at Passenger positions shall be carried out to determine the locations where the highest noise and tonality levels may occur on the upper and lower Saloons and in the End Saloons and doorway. Subsequent noise measurements shall be made at the locations identified as having the highest noise and tonality levels. The internal noise tonality shall not exceed the following limits:

- a) no third octave band with centre frequency below 160 Hz shall exceed 15 dB(A) above the level of adjacent third octave bands on both sides;

- b) no third octave band with centre frequency in the range 160 Hz to 400 Hz both inclusive, shall exceed 8 dB(A) above the level of adjacent third octave bands on both sides;
- c) no third octave band with centre frequency above 400 Hz shall exceed 5 dB(A) above the level of adjacent third octave bands on both sides; and
- d) the overall linear noise levels shall not exceed the overall A-weighted linear noise levels by more than 15 dB.

Where written complaints are received regarding internal noise tonality, PPP Co shall investigate the cause of the complaint, identify possible mitigating measures and advise RailCorp accordingly. PPP Co shall undertake any reasonable resulting corrective actions on all Sets to rectify the cause of the complaint.

With the Set running at speed up to and including the design speed on Class 1, Class IX, Class IC, Class IXC and Class 2 track (Refer TS3103), in open country with the HVAC system operating at maximum cooling/heating capacity (whichever is the noisier), noise at the middle of the upper Saloon shall not exceed 68 dB(A), not exceed 71 dB(A) in the middle of the lower Saloon and not exceed 74 dB(A) in the middle of the End Saloon or doorway Vestibule when measured using fast response and with the intercar doors closed.

With the Set running at track speed over a test section running from Hurstville to Bondi Junction and return to Hurstville, the noise at the middle of the Upper and Lower Saloon shall not exceed 70 dB(A) Leq, and shall not exceed 73 dB(A) Leq in the middle of the End Saloon when measured for 15 minutes using fast response and with the inter-car doors closed.

With the Set running at maximum design speed (130 km/h) on Class 1C or 1XC Tangent Track in open country the noise at the Driver's and Guard's ear positions shall not exceed a maximum of 73 dB(A) measured using fast response with all Cab equipment except for communications systems operating at full load.

With the Set stationary in open country, all auxiliary equipment operating at full load (except communications equipment which shall be in a quiescent state) and the HVAC system operating at maximum cooling/heating capacity (whichever is the noisier), the noise at any point in the Cabs or Passenger areas shall not exceed a maximum of 65 dB(A) measured using fast response.

#### 6.2.20 Internal Vibration

Vibration exposure of Crew and Passengers shall be in accordance with AS2670.1. The vibration exposure of the Crew shall not reach the health guidance caution zone for an 8-hour exposure in any of the axes (AS 2670.1 clause 7.3, which refers to Annex B). Clause 6.3.3 of ~~AS2670.2~~ AS2670.1 shall be used to determine if additional methods of evaluation are required.

The vibration exposure shall be assessed with the Set running at track speed over the Hurstville to Bondi Junction to Hurstville route.

#### 6.2.21 Livery

The front of the Set shall have a total area of not less than 1.5 m<sup>2</sup> of safety yellow (AS2700 Y15 "Sunflower") to highlight the Set to track maintenance personnel. A yellow panel of at least 1 m<sup>2</sup> projected vertical area shall be clearly visible from in front of the vehicle.

The amount of yellow visible from the side of the Car shall be minimised.

The external colour scheme of the Passenger bodyside doors shall be safety yellow (AS2700 Y15 "Sunflower") in accordance with the existing RailCorp fleet. The internal colour scheme shall provide a 50 mm safety yellow coloured stripe along the mating edges of the door panels (Passenger bodyside and intercar) and a 50 mm colour contrasted door frame.

Reflective delineators shall be fitted in accordance with RSU Appendix I, but shall be located well below the threshold of the Passenger body side doors to minimise the risk of confusion for Passengers with vision impairment.

RFTA  
00231

#### 6.2.22 Vehicle and Major Component Identification and Labelling

RFTA  
00309

Each Set shall be fitted with ~~a~~ passive vehicle identification tags. The tags shall comply with the requirements of RSU Appendix H Standard Alarm Tags for passenger vehicles.

The tags shall be fitted at a location on the Cars that allows ~~it~~ them to function correctly. The tags shall not detract from the exterior appearance of the Cars and shall be protected from damage from normal operational hazards and wash plant operations.

External signage, including the CityRail logo, Car number, train target, corporate colours, accessibility symbols or signage and striping shall be determined in consultation with RailCorp. Application of these items shall not occur until all on-track testing has been completed.

The Car number, in characters of at least 12 mm height, shall be stamped or otherwise permanently marked into the side of the underframe in a consistent unobstructed location in the vicinity of number eight (8) wheel without adversely affecting the underframe or any surface treatment thereof.

Wheel number locations shall be labelled above each wheel position, such that they are clearly visible for Maintenance Staff.

All low voltage and high voltage equipment and enclosures shall be marked with safety warning labels in accordance with CityRail Fleet Engineering Instruction EI 185 and shall comply with the requirements of AS1319.

PPP Co shall propose a component labelling scheme for the Set that shall cover all major components fitted to the Set.

#### 6.2.23 Protective Coatings

Protective coatings, including decals, shall be impervious to wash plant chemicals and general environment contaminants. Preparation and pre-treatment of surfaces shall, where applicable, be in accordance with AS 1627.

All interior surfaces shall be designed in a way so as to minimise glare, minimise wear and tear, be damage resistant and easy to clean.

The Set shall:

- a) have an appropriate anti Graffiti coating;
- b) be able to be cleaned by current approved RailCorp cleaning agents to a minimum of the same standard as existing rolling stock and ideally a higher standard. Where other cleaning agents are required these shall be notified to RailCorp.

### 6.3 Ballast Impact

Equipment below the underframe Sole Bar shall be designed to withstand, or be protected from, repeated impacts from ballast up to 75 mm across at speeds of up to 130 km/h.

### 6.4 Bogie

The bogie shall meet the applicable requirements of RSU 250, RSU 260, RSU 261, RSU 262 and RSU 263 unless otherwise specified, and be designed to comply with the interface requirements as defined within Rolling Stock Standard RSS 01. The bogie frame and major components shall be designed so that there will be no cracks during the life of the Set.

#### 6.4.1 RailCorp Bogie Dimensions

The requirements for RailCorp bogie dimensions are as follows:

- a) the wheel back-to-back distance at the rim shall comply with RSU 230
- b) wheel width shall be not less than 130 mm, including the flange and tread, and
- c) wheel profile shall conform with the profile WPR2000, defined by RailCorp's Drawing 3-83-01736



#### 6.4.2 Bogie Resonance

The bogie and its components shall not resonate within the Operational Speed Range.

##### 6.4.2.1 Dynamic Analysis for Natural Frequencies

Bogie natural frequencies shall be determined through out the Operational Speed Range in order to separate natural frequencies of the Car body structure from the bogies and avoid resonance, for all allowable wheel profile conditions and Defects.

#### 6.4.3 Bogie Stability

There shall be no Instability of the bogies or Cars in the form of sustained Hunting, pitching or bounce in any plane at all speeds up to 145 km/h for all allowable conditions of bogie component wear up to Condemning Limits.

#### 6.4.4 Curving Performance

The bogie design shall ensure that ~~minimise~~ the wheel flange-to-rail contact produced while negotiating curved track is less than 55kN under normal operating conditions.

The bogie shall incorporate features to specifically minimise wheel squeal particularly when negotiating curves.

PPP Co shall consider the addition of noise reducing measures to the Wheelsets to reduce Wheelset noise.

#### 6.4.5 Wheel and Axle Design and Manufacture

Wheels and the axles shall satisfy the requirements of RSU 211 and RSU 221 respectively.

Wheels shall be manufactured in accordance with RailCorp's Specification TRS0139 or TRS0147 as appropriate.

The wheel and axle assembly shall satisfy the requirements of RSU 230.

#### 6.4.6 Wheel Obstruction Deflector

The leading wheel sets on the Set shall be provided with obstruction deflectors to prevent obstructions on the track passing beneath the wheels.

The deflectors shall meet the requirements of Section 16 of UK Railway Standards & Safety Board, UK Railway Group Standard GM/RT2100 "Structural requirements for railway vehicles".

The deflectors shall be at a nominally constant height above rail, consistent with primary suspension deflection, and shall be adjustable to allow for the full range of wheel diameters.

#### 6.4.7 Fatigue Life Evaluation

PPP Co shall provide a fatigue life evaluation of the bogies conducted with an industry-recognised methodology that has been successfully applied to railway vehicles of similar characteristics operating in a similar operational environment. The methodology shall generally follow that shown within Appendix E – FEA and Fatigue Life.

#### 6.4.8 Listing and Justification of Applied Bogie Loads

PPP Co shall identify and describe all bogie loads, including bogie to body connection loads, used during the design. The descriptions shall include the basis for nominating the particular values adopted.

The attachment of all equipment fitted to bogie frames shall be designed in line with the requirements stated in the UK Railway Group Standard GM/RT2100 clause 15.

RFTA  
00133

#### 6.4.9 Axleboxes and Bearings

Axlebox bearings shall satisfy the requirements of RSU 240. PPP Co shall advise the proposed methodology to prevent axlebox bearings from overheating. If monitoring of axlebox temperature is not offered, then significantly over-rated bearings shall be used.

The attachment of all equipment fitted to axleboxes shall be designed in line with the requirements stated in the UK Railway Group Standard GM/RT2100 clause 17.

#### 6.4.10 Bogie Connections

RFTA  
00127 Bogie connections shall ~~not generate~~ ~~minimise the amount of~~ electrical noise ~~due to generated by the~~ changes in current sharing ~~due to changes in contact resistances with the rail~~ that interferes with any of the signalling or the Set systems. This is in addition to the requirements of RailCorp standard FE 117.

#### 6.4.11 Equipment Access

The bogie Subsystem shall provide easy and safe access for all Maintenance Staff, including access for Crew to operate the isolating cocks for bogie-mounted equipment and Park Brake manual release.

#### 6.4.12 Operation of Signalling System

All Wheelsets shall be able to operate the signalling system on an individual basis, including Wheelsets with worn wheel profiles.

#### 6.4.13 Bogie Codes and Serial Numbers

RFTA  
00238 PPP Co shall label every bogie with a code and unique serial number allocated by RailCorp, ~~as shown in drawing 305-827. The plate shall.~~ A plate with this information shall contain numbers/text of minimum size of 10mm in height, be located in easily accessible locations so they can be read whilst the bogie is fitted to the car, be fitted to a low stressed area of each bogie side frame and shall be a permanent fixture.

#### 6.4.14 Ride

Ride quality shall at least meet the requirements of RSU 642, but shall be no worse than the current ride characteristics achieved by CityRail's Millennium trains with recently overhauled bogie suspension system and with new wheel tread profile. The Set shall provide this ride quality for all speeds up to a speed of 130 km/h and 110 mm Superelevation deficiency through curves, whilst remaining within the Kinematic Rolling Stock Outline.

The Set shall achieve the ride quality specified above and further defined in Appendix F – Ride Quality, on track with the following nominated typical track parameters:

- a) measured under the dynamics of track recording Car AK (from which inertial track data will be available from RailCorp);
- b) based on 110 mm Superelevation deficiency through curves where the design rate of change of Superelevation is 65 mm/s; and
- c) at locations where non-transition curves exist, e.g. all turnouts;

whilst remaining within the Kinematic Rolling Stock Outline.

The bogie design shall be such that no instabilities which may lead to unsafe operation or deterioration in ride quality occur under any of the operating conditions, with dampers, wheel profiles and other bogie components in a worn condition or any combination of conditions from new to worn.

#### 6.4.15 Suspensions

The secondary suspension shall be self-levelling maintaining a nominal operating Vestibule floor height of 1270 mm ARL with new wheels. In the event of a Fault with the suspension the Driver shall be informed and the Set shall continue in service, at reduced speed if necessary until it can be removed from service.

The bogie shall have an external indicator to show that the suspension system is maintaining the Set at the correct height.

There shall be no safety valves or other components in the secondary suspension system that will cause a false signal to be sent to the load weigh system.

6.4.16 Air Spring Failure

If air springs are used and one or more air spring(s) deflate(s) on one or both bogies of a Car, then irrespective of its loading, the Car shall be retained in a safe stable configuration within the Kinematic Rolling Stock Outline for all track conditions up to a nominated speed. PPP Co shall state the maximum safe operating speed under these conditions, and in any case this shall not be less than 80 km/h. A fail-safe detection arrangement shall be used to notify the Driver of such Failure. The TOS shall record the occurrence of the failure and its location within the Set.

6.4.17 Deflated Air Spring Detection

The detection arrangement shall be positioned such that it cannot be damaged during movement of the bogie. In the event of an air spring deflating, the Car shall remain level in the transverse direction, when stationary on Tangent Track.

6.4.18 Air Conservation on Twisted Track

RFTA  
00142

If air springs are used, the Subsystem shall ~~conserve air~~ not release air whilst the Car is slowly negotiating or standing on ~~twisted track with a twist up to 1:350~~. On track with a twist exceeding 1:350, air shall not be released to the extent that suspension, braking or any other subsystem do not meet the requirements of this RailCorp Train Performance Specification.

6.4.19 Train Trip Gear

A Trip Gear assembly shall be mounted on the number eight-wheel axlebox below the Driver's position as referenced in Appendix D - Door Positions and Axle Numbers of each end Car of the train.

The Trip Gear and its mounting shall withstand repeated contact at maximum speed with a raised signal Train Stop while still activating the trip. The height of the trip shall be adjustable to allow for height variations such as wheel wear and wheel turning. Trip Gear shall not fail due to the activation in the reverse direction such as back tripping. Back tripping at speeds of not greater than 25 km/h shall not cause an application of the brakes.

RFTA  
00056

The leading and trailing Trip Gear shall always be lowered. When two Sets are coupled (i.e. 16 Cars) the intermediate Trip Gears shall be capable of being raised and isolated. ~~When the two Sets are uncoupled via the uncouple control on the active Driver's Workstation, the Trip Gears and their controls shall be automatically set to the correct operational state.~~

**6.5 Coupling and Drawgear**

The Set shall be fitted with two types of coupler:

- a) Scharfenberg Type 10 compatible at the outer ends; and
- b) Semi Permanent coupler at the inter Car positions.

6.5.1 Scharfenberg Type 10 Compatible

The coupler shall be capable of coupling mechanically and pneumatically at speeds of up 32 km/h with a Scharfenberg Type 10 coupler. The coupler shall remain an effective component within the crashworthiness system up to a speed of 55 km/h. An emergency coupler adaptor shall be provided to fit to the outer end coupler. The contour of the emergency coupler shall be in accordance with RailCorp Drawing 2-82-00651.

The design of the emergency coupler adaptor shall allow deployment by one person in accordance with the requirements of NOHSC:1001 and NOHSC:2005.

### 6.5.2 Semi-Permanent Coupler

Semi-permanent couplers shall be fitted between all Cars of the Set and will be uncoupled for maintenance or incident recovery only.

Any equipment excepting cables and hoses at the Car ends shall be self-supporting in the event of the Set being uncoupled.

#### 6.5.2.1 Pneumatic Interface Operation

When a Set is coupled to another Set or another train, the brake control and main reservoir air shall be made available throughout both trains via the outer end couplers or the emergency couplers, as applicable.

### 6.5.3 Draftgear

The Draftgear shall be capable of repeatedly withstanding all in-service buff forces and draft forces sufficient to pull and push a non-powering AW3 loaded Set up a 1 in 25 gradient including all curves, against train resistance and acceleration forces, with safety.

#### 6.5.3.1 Coupling Forces

The couplers shall be capable of withstanding a minimum static tensile load of 1.0 MN and a compressive load of 1.6 MN, without permanent deformation of the coupler components.

For the various coupler types, the couplers, as mounted between two Cars, shall withstand a combined load of 100 kN transversely and 100 kN vertically applied at one end and restrained at the other without permanent deformation.

#### 6.5.3.2 Coupler retention

The Set shall be designed such that, in a collision, if the coupler breaks away on completion of the energy absorption it will do so in a safe manner.

### 6.5.4 Intercar Jumpers

Intercar cables carrying heavy currents or Low (greater than 32 V ac or 120 V dc) or High Voltages shall be interlocked so that power is not present prior to connection being made or broken. Refer to FE 116..

Headshells shall be electrically bonded to earth potential.

RFTA  
00253

If high-tension intercar connections are included, they shall be protected against damage from foreign objects as per IP65 of ~~AS 1939~~ AS 60529, and insulated to withstand undercarriage cleaning including the use of water jet sprays.

#### 6.5.4.1 Earthing

The intercar interface shall provide a secure electrical earth equipotential to the Car body. The Car body shall not be used as a return path for auxiliary, control or other devices.

### 6.5.5 Gangway

The gangway interface shall provide an easily cleaned, low maintenance, weatherproof, draught-proof environmental barrier and allow the safe and obstacle-free passage of Passengers and Crew. In the event of a collision, at any speed lower than that at which the adjacent crumple zone sustains deformation/damage, deformation/damage to the gangway shall be minimised.

#### 6.5.5.1 Gangway Exterior

The exterior intercar connection shall be designed to minimise the gap between it and the platform to prevent Passengers at platforms climbing or falling into the gap or for those with vision impairment mistaking the gap for an open door.

6.5.5.2 *Gangway Interior*

The gangway interior shall be compliant with DIN EN 349.

The gangway shall be sealed so that the movement of litter and objects greater than 5 mm in size to below the floor of the gangway is minimised.

The gangway shall be designed such that any litter dropped by users can be readily removed to eliminate any potential fire or health hazard, without having to disconnect Cars or remove access panels.

The level of illumination provided in the gangway shall be between 90% and 100% of the levels specified for the Passenger areas.

The gangway shall not retain water or liquid spills.

**6.6 Windows**

All windows shall provide an effectively transparent environmental separation between the interior of the Set and the external environment or adjacent Car.

- a) All windows shall comply with Section 1 of FE 108, except for the windscreen, which is detailed in clause 6.6.7 (Windscreens) of this RailCorp Train Performance Specification;
- b) All windows shall be highly resistant to acts of Vandalism involving the etching or scratching of the glass;
- c) All windows shall facilitate the rapid remediation of etching or scratching;
- d) All windows shall be easily cleaned and shall be impervious and chemically unaffected by water, paint, human waste, Graffiti removers, washplant solutions, cleaning solutions, food and drink spills;
- e) All windows shall be highly resistant to damage arising from the impact of ballast (see clause 6.3 (Ballast Impact) of this RailCorp Train Performance Specification);
- f) All windows shall have rebate depths of not less than 35 mm or which when combined with an adjacent armrest at the same height as the window sill provides a total depth greater than 50 mm
- g) All windows shall have a PVB interlayer of not less than 1.5 mm except for the windscreens which shall have either a polyvinyl butyral (PVB) interlayer or a polyurethane (PU) interlayer of not less than 1.5 mm;
- h) All windows shall have a direct solar heat transmission of less than 30%, except the windscreen and Crew Cab windows which shall have a direct solar heat transmission of less than 45%;
- i) All bodyside windows shall transmit not less than ~~47%~~50% of the incident visible light, except Crew Cab windows which shall transmit not less than 70% of visible light; and
- j) All windows shall have a visible light reflectance, both inside and outside, of not greater than 7%, except the glazing for draughtscreens, stairwell centre partitions, IDI / CCTV and CCTV cover screens which shall have a visible light reflectance of 7% +/-2%.

RFTA  
00231

RFTA  
00006

RFTA  
00355

RFTA  
00017

RFTA  
00318

Broken windows shall be retained in situ and held intact to allow the Set to continue to operate at normal speed without endangering Passengers, Crew or trackside personnel.

The design shall facilitate or minimise the time and cost required to repair, remove, install, and refit new glass panels. The time for this shall not exceed 4 hours including any curing time.

It shall not be possible for Passengers to push or kick the windows or frame out from inside the Car.

6.6.1 *Crew Cab Windows*

Windows shall be provided as part of each Crew Cab.

The Crew Cab windows, including Crew Cab bodyside door windows and side windows, with the exception of the windscreen:

- a) shall have a total panel thickness not less than 12 mm; and

- b) shall meet the testing requirements of FRA Type 2 Specification 49 CFR Part 223 Appendix A except that the large object impact speed shall be 6.5 m/s

All windows in the Crew Cab (including those fitted to Crew side doors) shall be fitted with blinds or similar to control light interfering with the Crew's vision of controls and instrumentation. On any forward-facing windows, the blind operation shall be restricted such that vision through the lower 100 mm of the window cannot be obstructed.

6.6.2 Crew Bodyside Door Windows

Crew bodyside access doors shall be provided with opening windows.

RFTA  
00100

- a) The Crew bodyside access door window opening shall be a minimum of ~~200 mm high by~~ 350mm wide with an aperture that ~~The opening shall prevent Crew putting their head through the open window;~~
- b) The latch shall be sufficiently robust to withstand 500 N and not require more than 50 N to operate;
- c) The Crew bodyside access door windows shall not require more than 50N force to open or close; and
- d) The Driver shall be informed by TOS if any of the Crew bodyside access doors or Cab windows are open when the washing mode is selected.

6.6.3 Hold Position

6.6.4 The open window shall maintain its set position during motion of the Set.

6.6.5 Crew Bodyside Windows

Crew bodyside windows shall be provided on each side of the Cab.

The Crew side windows shall be designed to provide the field of vision consistent with the requirements for operation and satisfy the Car structure, Crew protection and energy absorption.

6.6.6 Passenger Windows

The total area of window glass allowing entry of external natural light into the Passenger areas of the Car shall not be less than 26 m<sup>2</sup> evenly distributed throughout the Car including Passenger bodyside doors.

The Passenger bodyside doors shall include windows, which shall provide clear visibility to and from the platform under all operating environments. The minimum window size shall be not less than 0.8 m<sup>2</sup> per door leaf.

The Passenger bodyside windows shall meet the testing requirements of FRA Type 2 Specification 49 CFR Part 223 Appendix A, except that the large object impact speed shall be 6.5 m/s for side windows. Additional testing shall include the testing of a Passenger bodyside window, mounted in its frame (if applicable), being subjected to a twist of 60mm diagonally across adjacent corners to ensure the window shall be retained when the load cases as stipulated in Section C3 of UK Railway Group Standard GM/RT2456 are applied.

Bodyside windows shall not follow the bodyside contour into the roof, but shall be aligned with the Car bodyside plane.

Bodyside windows shall be bonded to the bodyside structure and shall not be retained by key rubbers or similar fixings.

RFTA  
00322

Bodyside windows, Passenger bodyside door windows and guard's windows shall have 3M safety and security film specification type SH8CLARL applied to the internal surface, post installation of the windows into Cars.

Film shall be applied to bodyside, Passenger door windows and guard's windows by 3M licensed installers only.

Film shall be pre-cut to exact sizes by installers using Computer Numerically Controlled cutting techniques. Detailed trimming of film in-situ will not form part of the application process.

Film application methods shall be designed to facilitate ease of future replacement.

6.6.6.1 *Sill Width and Height*

All Saloon windows adjacent to transverse seating shall be provided with an internal sill of sufficient width and shape and at a height of 225 mm ± 25 mm above the level of the compressed seat squab to be used as a Passenger armrest.

6.6.7 *Windscreens*

The windscreen shall comply with FE 107.

The windscreens shall not be tinted or polarised in any way that may affect the interpretation of a colour light signal.

The windscreen shall conform to the requirements of UK Railway Group Standard GM/RT/2456 [C.2].

RFTA  
00047

No windscreen equipment shall impair the Driver's line of sight other than windscreen wiper arms and blades whilst in operation.

6.6.7.1 *Windscreen Retaining Mechanism*

The windscreen retaining mechanism used in the Car construction shall be capable of holding the windscreen in place during all specified impacts and collisions.

6.6.7.2 *Windscreen - Emergency Exit Door Glass*

Requirements for each windscreen, including the windscreen wiping and washing mechanism, shall also apply to any glass fitted in the front emergency access system.

6.6.7.3 *Minimum Thickness*

All forward-facing windscreens in the Cab area shall have a minimum thickness of 18 mm.

6.6.7.4 *Windscreen Failure*

RFTA  
00122

In the event of Failure, the glass shall break such that sufficient visibility is maintained to operate the Set in accordance with the Train Operations Manual ~~to complete the run safely~~ and shall also comply with the requirements of UK Railway Group Standard GM/RT2456 [C2.2].

6.6.7.5 *Windscreen Demister*

The windscreen(s) shall be fitted with a method to de-mist the windscreen(s) within 10 minutes from Set start up and then maintain clear vision under the worst combination ambient conditions. Where deposited film demisting elements are used they shall operate at the nominated control voltage, and the electrical elements and connections shall be protected from access by the Crew.

The system shall have no adverse effect on the windscreen.

**6.7 Doors**

All doors shall conform to RSU 630 and include the requirements detailed below:

The Car body shall include water deflectors or guttering over doorways to redirect water from the Car body sides and to the Car body ends so that it does not fall onto Passengers or Crew during normal operation at any time.

The door panels, seals and other components shall not generate tonal noise, either internally or externally at any speed up to and including Maximum Operational Speed.

The operating times and reset attempt settings of the doors shall be adjustable at RailCorp's request.

RFTA  
00093

All doors and equipment, including handrails, pillars and controls, shall be designed ergonomically ~~designed to provide a user friendly environment~~ and to prevent injury to users. In this respect, particular attention shall be paid to the layout of handrails and ensuring that other than the door edge meeting the doorframe or another door the design of the door and equipment in its vicinity does not create any closing gaps.

RFTA  
00118

All doors fitted with EDRs shall be fitted with external and internal ~~handles~~handgrips to permit manual opening or closing in the event of activation of the EDR associated with the door.

#### 6.7.1 Passenger Bodyside Doors

The doors form a main Passenger interface and will be subject to significant levels of rough handling and abuse during day to day operation. The door system shall be designed and tested to provide reliable operation within this environment.

The Passenger bodyside doors shall be opened by use of:

- a) Automatic controls operated by the Crew;
- b) Local controls at each door position not available to Passengers; and
- c) Internal and external emergency release controls to release the doors allowing them to be pushed out from the carbody and then opened.

The Passenger bodyside doors shall be closed and locked by:

- d) Automatic controls operated by the Crew;
- e) Local controls at each door position not available to Passengers;
- f) Nightsafe controls; and
- g) Manually pushing the door to the closed and locked position.

##### 6.7.1.1 Minimum Dimensions

The Passenger bodyside doors shall provide a minimum unobstructed opening not less than 1800 mm wide by 1920 mm high and the associated handrails shall provide a minimum unobstructed opening not less than 1800/1720 mm wide by 1920 mm high. At the TDC No. 2 End, the Passenger bodyside door handrails shall provide a minimum unobstructed opening not less than 1660 mm wide. If a vertical handrail is provided in the door opening a minimum clear opening of 900 mm shall be provided between handrails on the side closest to the designated Wheelchair Spaces to ensure access of Passengers with mobility aids.

RFTA  
00235  
RFTA  
00220

##### 6.7.1.2 Door Strength

Each door leaf and its supporting structure shall withstand a horizontal, outwardly directed force of 2 kN applied to the leading edge at mid-height without the door releasing and without any permanent deformation. The total Lateral displacement under the above force shall not exceed 35 mm. Door operation and external water spray tests shall be conducted after removal of the above forces to verify that door framing and sealing are not impaired.

Each door leaf and its supporting structure shall withstand a force of 4 kN uniformly distributed across the waist-rail height of the door leaf. Permanent damage to the door and support structure may be accepted, however, there shall be no damage to the body structure. Passenger containment shall not be impaired.

##### 6.7.1.3 Passenger Door Safety

The Passenger bodyside doors shall be designed to avoid risk of injury, either directly or by entrapment, to Passengers during any phase of the door operation. During normal operation the doors shall be restrained from being manually closed when in the opened position.

Passenger bodyside door operating equipment shall be concealed as far as reasonably practicable from unauthorised personnel at all stages of door operation.



With the Set stationary and any Passenger bodyside door on the Set not closed and locked, the control system shall prevent the Set from powering via its normal mode of operation. It shall be possible to override such protection by the isolation of the defective door(s) and/or the defective control circuit. The Circuit shall be Fail-safe and shall provide a positive signal when doors are proven closed. A facility shall be provided to allow the Driver or Maintenance Staff to check the continuity of the door/traction interlock circuit at any time.

RFTA  
00303

If the Passenger bodyside door fails to operate under its normal operating system it shall be possible for the Crew to manually open or close and lock the doors. If a door fault or loss of security occurs whilst the Set is in motion, there shall be an alert to the Crew, but no loss of Driver control whilst the Set is above 5km/h. At or below 5km/h, traction interlocking shall apply.

The Passenger bodyside door control system shall be arranged such that Failure of any non-door related equipment does not affect door opening, closing and locking. The system shall be arranged such that Failure in any door equipment is localised and does not affect the operation of other doors, either on that Car or other Cars.

In the event of power loss to the door when in the closed state the door shall remain closed and locked.

With any Passenger bodyside door in any open position (including partially open and fully open), the doors and any necessary restraining devices shall be designed to withstand the forces encountered when the Set travelling at 65 km/h enters a tunnel or passes a stationary train.

#### 6.7.1.4 Tread Plate

A slip resistant tread plate, colour contrasted to the surrounding floor, shall be provided at the base of the doorway, installed across the full width of the doorway when in its open position. The tread plate shall clearly define the edge of the floor across the doorway opening.

#### 6.7.1.5 Opening Time

The Passenger bodyside doors shall fully open in not greater than 4.5 seconds from the instant the Crewmember operates the door open button. The maximum operating time shall be adjustable and shall be capable of being changed by PPP Co at no cost to RailCorp after service trials or upon request.

#### 6.7.1.6 Closing Time

The Passenger bodyside doors shall, from the instant the Crewmember operates the door close button, fully close and secure in not greater than 6 seconds if not obstructed. The maximum operating time shall be adjustable and shall be capable of being changed by PPP Co at no cost to RailCorp after service trials.

Doors shall not close in less than 4 seconds in order that Passenger injury, particularly to children, the elderly and infirm is avoided. PPP Co shall provide calculations to show that the door timing meets this requirement.

#### 6.7.1.7 Obstruction Detection

The doors shall be fitted with a door edge rubber to buffer the effect of an impact with a Passenger on closing.

The doors shall incorporate door obstruction detection that will detect an obstruction as small as 15 mm width.

Each doorway shall be fitted with an automatic re-opening facility. On detection of an obstruction the doors shall behave as follows:

- a) if, during the first attempt to close, a door senses the presence of an obstruction, the door shall reopen to full width and remain open for a limited amount of time before attempting to close again. The Crew shall be notified of the door obstruction and its location;
- b) if, on the second attempt to close, the door senses the presence of an obstruction, the door shall re-open by at least 100mm for each leaf (a total of at least 200mm) before attempting to close again;

c) if, on the third attempt to close, the door senses the presence of an obstruction, the door shall re-open by at least 100mm for each leaf before attempting to close again and a Passenger shall be able to push the door back further;

d) if, on the fourth attempt to close, a door senses the presence of an obstruction, the door shall open to full width and remain in this state until reset. View of the failed door shall be made available to the Crew via the surveillance screen; and

e) to reset the door, the Crew shall operate the bodyside door close control to restart the closing cycle.

The doors shall be locked once closed.

It shall not be possible to open doors whilst the Set is in motion at above 5km/h.

6.7.1.8 Door Closing Force

The door closing Effective Force shall be no more than 160 N throughout its complete closing sequence., The door closing Peak Force shall be no greater than 240 N at any time during the door closing cycle.

6.7.1.9 Door Delay Time

The delay between the door beginning to either close or open, from initiating command being given by the Crew, shall be not greater than 0.5 seconds.

6.7.1.10 Passenger Bodyside Door Locking

The Passenger bodyside doors shall on closing, secure in a manner that prevents unauthorised opening from the interior and exterior of the Set. The doors shall remain in the locked condition until opened by an authorised person or by the use of the Emergency Door Release (EDR).

It shall be possible to close and lock the Passenger bodyside doors manually from inside and outside the Car. External closing and locking shall be possible from track level.

6.7.1.11 Door Short Cycling

During door closing, the Crew shall be able to cause the doors to re-open by operating the "Door Open" command. Under these conditions the door shall immediately begin to re-open. The doors, and control equipment, shall not suffer degradation as a result of short cycling.

6.7.2 Passenger Door Control

RFTA  
00013  
RFTA  
00014

Passenger bodyside doors shall be controllable (open and close) from each of the Crew's door control stations located in the Cabs. ~~In addition, it shall be possible for the Passenger bodyside doors on the rearmost Car, two (2) rearmost Cars and four (4) rearmost Cars in the Set to be selected to open. It shall also be possible for the doors on the lead Car and independently the doors on the leading two Cars nearest to the outer ends of the Set to be prevented from opening in the event that the Set overshoots or undershoots a platform. This functionality shall be provided by a one Car overshoot control and a two Car overshoot control.~~

It shall not be possible for the Crew to open the Passenger bodyside doors whilst the Set is moving at speeds above 5 km/h. The controls located on a particular side of the Set shall control the doors on that side of the Set only.

RFTA  
00037

Additional door controls shall be located behind access panels at each Passenger doorway. These local door control panels shall provide the following functions:

- a) local door open by push button; and
- b) local door close by push button.
- c) local door isolation by rotary switch
- d) all side door open by push button (one side only)

e) all side door close by push button (one side only).

6.7.2.1 *DVA and Door Closing*

RFTA  
00039  
  
RFTA  
00022

To close the Passenger bodyside doors, two buttons shall be provided to the Crew. The DWD button shall activate~~One operating~~ the DVA announcing the closure of the doors and another button to activate the closing cycle of the door control. The second button shall be required to be operated within an eight-second time gap from pressing the DWD DVA button. If the time gap is greater than eight seconds, the DWD button ~~voice annunciation~~ shall have to be pressed again to initiate another voice annunciation initiated again.

Door Close shall close Passenger bodyside doors including doors opened by the EDR device.

A rapid reclose feature shall be provided to close the passenger doors without the DVA message if the "Door Close" button is pressed within 2.5 seconds of pressing the "Door Open" button.

A DWD button is not required at the additional door controls located at each Passenger doorway.

6.7.2.2 *Door Fault Indication*

After the command to close and lock the Passenger bodyside doors is received, the Crew shall be alerted if this action has not been completed for all doors on the Set.

In the event of any door fault or loss of security, pertinent door information, including information on door status, Car number and door number, shall be displayed to the Crew.

RFTA  
00022  
  
RFTA  
00198  
  
RFTA  
00022

6.7.2.3 ~~Internal~~ *Door Emergency Operation*

Emergency Door Releases (EDR), accessible to all Passenger groups, shall be located on two diagonally opposite Passenger bodyside doors on each Car (number 2/4 and 5/7 doors), and on all intercar doors and Crew transverse doors.

An EDR control and signage shall be provided to enable the doors to be opened. The time to fully open or fully close each door for an able-bodied Passenger using the EDR shall not exceed 1 minute each, even under emergency conditions. All ~~internal~~ EDR controls shall be of ~~the same~~ a similar type and operate in functionally ~~the same~~ a similar manner. EDR controls shall be operated by a linear action not a rotary action. EDR controls shall be located immediately next to the door they operate. The control shall be keyless and capable of being accessed under emergency conditions by a non-trained person.

With the exception of external EDRs, the operation of an EDR will require the removal of a tamper proof sealing device (EDR Stage 1 Activation), before the EDR is available for use (EDR Stage 2 Activation).

~~To operate an EDR a sealing device, that deters tampering, will need to be removed before the actual EDR control can be used. Both the removal of the seal and Activation of the EDRs shall be recorded on TOS and in the Event Recorder:~~

A time delay T1, configurable from 0 seconds to 600 seconds in 5 second increments, shall be initiated after a Stage 1 Activation during which, Stage 2 Activation is inhibited. Changes in configuration to the time delay function T1 shall only be made by a maintenance action, and shall be simple to carry out. These changes shall only occur on demand by RailCorp.

EDRs shall still operate even in the event of the Main Power Supply being unavailable, the main reservoir system being depleted and no lighting or control battery power being available. If a Car has rolled on to its side, the EDR control, on the door facing upwards, shall allow the release of the locking mechanism of that door and ~~any doors facing upwards-it~~ shall be capable of being opened manually.

~~Activation of EDRs accessible to Passengers shall be linked to both the PEI and the CCTV system. The Crew shall be alerted at both the breaking of the EDR seal and at the activation of the EDR. Similarly, the~~

~~nearest PEI shall be activated and the CCTV shall record both the breaking of the EDR seal and at the activation of the EDR.~~

~~In addition, Passenger bodyside door EDR controls shall be located as near as practicable to a PEI.~~

~~The EDR controls at the following locations shall operate as follows:~~

~~a) All bodyside Passenger door EDRs shall be locked out of operation once the vehicle speed exceeds 5 km/h or when the Car is Stabled. They shall only be active below 5 kph in normal driving mode.~~

~~b) EDRs within a gangway area shall always be active.~~

~~c) EDRs that allow access to a gangway area shall always be active.~~

~~d) EDRs into a Guard's Cab shall be enabled in the following two circumstances:~~

~~i) in the event of a second stage fire alarm; and~~

~~ii) in the event that a PEI activation is escalated to the Train Radio system as described in clause 11.4.5 below.~~

~~e) EDRs allowing access into a Driver's Cab shall not be enabled when the Set speed is 5 kph or above. At speeds below 5 kph EDRs allowing access into a Driver's Cab shall be enabled in the following two circumstances:~~

~~i) in the event of a second stage fire alarm; and~~

~~ii) in the event that a PEI activation is escalated to the Train Radio system as described in clause 11.4.5 below.~~

~~EDRs shall be controlled by an EDR control system central controller which can be reprogrammed easily (i.e. all Sets shall be reprogrammed within 48 hours of notification by RailCorp) in the event of a change to RailCorp's EDR protocols. The EDR control system controller shall receive the following inputs~~

~~i) PEI escalation to Train Radio from any Car;~~

~~ii) speed  $< 5 \text{ km/h} \leq 5 \text{ km/h}$ ;~~

~~iii) second stage fire alarm from any Car; and~~

~~iv) Emergency Brake application.~~

~~EDRs shall be enabled when power is lost or disconnected from the EDR control system central controller. Activation of the EDR control shall be recorded in TOS and in the Event Recorder.~~

~~Except for Intercar EDR controls which shall self reset, all EDRs shall be reset when the EDR control returns to the stored position and the associated door is fully closed. All EDR sealing devices shall be reset by returning them to their original shut position.~~

~~See Appendix AA for EDR Functionality Table.~~

### **6.7.2.3.1 Internal Passenger Bodyside Door EDRs**

~~Internal Passenger bodyside door EDR controls shall be located as near as practicable to a PEI.~~

~~EDR controls shall be provided with a visual indicator to advise when the EDR is available for EDR Stage 2 Activation. The indicator shall not be visible until the EDR sealing device has been removed. The indicator shall display a light when the EDR is not available for EDR Stage 2 Activation, following an EDR Stage 1 Activation.~~

Normal State:

Activation of internal Passenger bodyside door EDRs shall be linked to both the PEI and the CCTV system. The nearest PEI shall be activated, the Crew alerted, and the CCTV storage units shall record both EDR Stage 1 and Stage 2 Activation.

The EDRs shall be unavailable for operation once the vehicle speed exceeds 5 km/h.

To further deter tampering, a local Passenger audible alarm shall be triggered by the EDR Stage 1 Activation. The EDR Stage 1 alarm shall be muted by the Crew answering the PEI call. Upon termination of the PEI call, the local alarm shall recommence, until cancelled by the closure of the EDR sealing device.

Both EDR Stage 1 and Stage 2 Activation of the EDRs shall be recorded on TOS and in the Event Recorder.

Stabled State:

As a configurable item, the internal EDR Stage 2 Activation shall be able to be made active in the stabled state.

Changes in configuration shall only be made by a maintenance action, and shall be simple to carry out. These changes shall only occur on demand by RailCorp.

**6.7.2.3.2 External Passenger Bodyside Door EDRs**

Storage units shall record EDR Stage 2 Activation. The Crew shall be alerted at EDR Stage 2 Activation only.

External EDRs shall be accessible from both the platform and when standing at track level.

In addition to being located next to the door they operate, EDR controls shall not be covered by the opening of any door.

The external Passenger bodyside door EDR sealing devices shall be fitted with a self closing mechanism.

The EDRs shall be unavailable for operation once the vehicle speed exceeds 5 km/h, and when the Set is Stabled.

Only EDR Stage 2 Activation of the EDRs shall be recorded on TOS and in the Event Recorder.

**6.7.2.3.3 Intercar Door EDRs**

Intercar Door EDRs shall always be active, unless configured to be inactive when the Intercar Door is isolated. Changes in configuration shall only be made by a maintenance action, and shall be simple to carry out. These changes shall only occur on demand by RailCorp.

Activation of intercar door EDRs shall be linked to the CCTV system. The CCTV storage units shall record both EDR Stage 1 and Stage 2 Activation at all times.

When a Car is isolated or in the Nightsafe state only, the EDRs shall have the following functionality:

- i) The CCTV monitors in the Crew Cab shall display the image from the camera giving coverage of the EDR device.
- ii) The Crew shall be provided with an alarm at both EDR Stage 1 and Stage 2 Activation
- iii) Both EDR Stage 1 and Stage 2 Activation of the EDRs shall be recorded on TOS and in the Event Recorder.

RFTA  
00198

RFTA  
00022

RFTA  
00198

<p>RFTA 00198</p>	<p>iv) <u>On activation of an EDR releasing an intercar door giving access to a car in Nightsafe state, that Car shall revert to Normal state.</u></p>
<p>RFTA 00022</p>	<p><u>The availability of the Crew alarms shall be configurable to operate in all operational states. The configuration changes shall only occur on demand by RailCorp.</u></p> <p><u>Intercar EDRs shall self-reset to normal functionality after a period initially set to 60 seconds after they have been operated, with this time period to be configurable from 0 seconds to 300 seconds in 5 second increments. Changes to this time period shall be made by a maintenance action, and shall be simple to carry out. These changes shall only occur on demand by RailCorp.</u></p> <p><u>To further deter tampering, a local Passenger audible alarm shall be triggered by the EDR Stage 1 Activation. The EDR Stage 1 alarm and the local Passenger alarm shall be cancelled by closure of the EDR sealing device.</u></p>
<p>RFTA 00198</p>	<p><b><u>6.7.2.3.4 Crew Transverse Door EDRs</u></b></p> <p><u>All Crew transverse doors shall be fitted with EDRs on the Saloon side only.</u></p> <p><u>Activation of saloon side Crew transverse door EDRs shall be linked to both the PEI and the CCTV system. The nearest PEI shall be activated, the Crew shall be activated, and the CCTV storage units shall record both EDR Stage 1 and Stage 2 Activation.</u></p> <p><u>The EDR controls shall be located as near as practicable to the Saloon side transverse door.</u></p> <p><u>To further deter tampering, a local Passenger audible alarm shall be triggered by the EDR Stage 1 Activation. The EDR Stage 1 alarm shall be muted by the Crew answering the PEI call. Upon termination of the PEI call, the local alarm shall recommence, until cancelled by the closure of the EDR sealing device.</u></p> <p><u>EDR controls shall be provided with a visual indicator to advise when the EDR is available for EDR Stage 2 Activation. The indicator shall not be visible until the EDR sealing device has been removed. The indicator shall display a light when the EDR is not available for EDR Stage 2 Activation.</u></p>
<p>RFTA 00198</p>	<p><u>EDRs allowing access into a Crew Cab shall be unavailable for operation once the vehicle speed exceeds 5 km/h, or when the Crew Override facility is activated. At speeds of 5 km/h or below, EDRs shall be activated only when the Crew Override facility is not activated, and either of the following two circumstances occurs</u></p> <ul style="list-style-type: none"> <li><u>i) in the event of a second stage fire alarm; or</u></li> <li><u>ii) in the event that a PEI activation is escalated to the Train Radio system as described in clause 11.4.5.</u></li> </ul> <p><u>Both EDR Stage 1 and Stage 2 Activation of the EDRs shall be recorded on TOS and in the Event Recorder.</u></p> <p><b><u>6.7.2.3.5 Crew Override Facility</u></b></p> <p><u>A Crew Override control shall only be capable of functioning after a Stage 1 activation. The Crew Override shall be provided as follows:</u></p> <ul style="list-style-type: none"> <li><u>(i) for internal Passenger bodyside doors and Crew transverse doors, to prevent an EDR Stage 2 Activation after receiving an EDR Stage 1 alarm, and</u></li> <li><u>(ii) as a configurable option, for the Crew transverse door EDRs only, to prevent an EDR Stage 2 Activation when there is no active cab.</u></li> </ul>
<p><u>A separate control shall be provided to cancel a Crew Override command from an active cab.</u></p>	

<p>RFTA 00198</p>	<p><u>The controls shall be able to be operated whilst viewing the CCTV surveillance monitors. The control panel shall include indicators displaying EDR Stage 1 and Stage 2 Activation of the EDRs.</u></p>
	<p><u>The Crew Override facility, when enabled, shall disable the EDRs for a time delay T2. This time period T2, shall be configurable from 0 seconds to 3600 seconds in no greater than 15 second increments. Changes in configuration to the time delay function T2 shall only be made by a maintenance action, and shall be simple to carry out. These changes shall only occur on demand by RailCorp.</u></p>
	<p><u>The Crew Override push button shall illuminate when the facility has been activated, and time delay T2 is counting down. It shall extinguish once time delay T2 has elapsed, or the Crew Override Cancel push button has been pressed.</u></p>
<p>RFTA 00022</p>	<p><u>Operation of the Crew Override and Crew Override Cancel shall be recorded in both TOS and the Event Recorder.</u></p>
<p>RFTA 00372</p>	<p><u>Restarting or initiation of the Crew Override T2 timer at any time whilst an EDR cover is open point during the elapsing time period shall be initiated-achieved by repressing-depressing the EDR Crew Override illuminated push button.</u></p>
<p>RFTA 00372</p>	<p><u>(A Crew Override shall not have any effect on an emergency door that has already undergone EDR Stage 2 Activation.)</u></p>
<p>RFTA 00046</p>	<p><u>The controls shall prevent continual activation caused by the buttons being stuck down, or held down, or through damage to the Crew Cab in the event of a collision.</u></p>
	<p><u>If Crew Cabs are deactivated by the removal of the Crew's key after the initiation of the Crew Override facility, the Crew Override time delay T2 shall continue until fully elapsed.</u></p>
	<p><u>6.7.2.4 External Door Emergency Operation Not Used</u></p> <p><u>Emergency Door Releases (EDR), accessible from both the platform and when standing at track level, shall be located on two diagonally opposite Passenger bodyside doors on each Car (number 2/4 and 5/7 doors). An EDR control behind a flap, with adjacent signage to EI 166, shall be provided to enable the doors to be opened. The time to fully open or fully close each door for an able bodied Passenger using the EDR shall not exceed 1 minute each, even under emergency conditions. The control shall be keyless and capable of being accessed under emergency conditions by a non-trained person.</u></p> <p><u>All external EDR controls shall be of the same type and operate in functionally the same manner. EDR controls shall be operated by a linear action not a rotary action. EDR controls shall be located next to the door they operate, and shall not be covered by the opening of any door. The controls shall still operate even in the event of the Main Power Supply being unavailable, the main reservoir system being depleted and no lighting or control battery power being available. If the Car has rolled onto its side the EDR control shall allow the release of the locking mechanism and doors facing upwards shall be capable of being opened manually.</u></p> <p><u>EDRs shall be enabled when power is lost or disconnected from the EDR control system central controller. Activation of the EDR control shall be recorded in TOS and in the Event Recorder.</u></p>
	<p><u>6.7.2.5 Self-Monitoring</u></p> <p><u>The door controls shall include the self-detection of faults and failures including monitoring door performance to detect changes that would lead to failure if not corrected. Information shall be provided to the maintenance system within the TOS.</u></p>
	<p><u>6.7.3 Intercar Access Doors</u></p> <p><u>Lockable bi-parting intercar doors shall be provided at each end of each Car, not including the terminal ends of each Set, or any Car end adjacent to a Car end incorporating a Guard's Cab. At these locations a Crew transverse door shall be provided. At any Car end incorporating a Guard's Cab, a lockable manually operated sliding door shall be provided.</u></p>

Letter  
RC00273

The doors shall be power opening and closing. The opening operation shall be user initiated permitting Passengers and Crew to move from one Car to another. User activation shall open both intercar doors on adjacent Cars at that location in one operation.

It shall be possible for a Passenger in the gangway between the intercar doors to open either door set and gain entry to a Car.

Access between the Cars shall be possible even when the doors have no external power.

During Nightsafe operation the doors on one or more Cars shall be locked by the Crew. Refer to the Nightsafe state requirements. When locked, the doors shall prevent access to the Cars by Passengers except when required for emergency egress.

RFTA 00322	<u>Intercar access door windows shall have 3M safety and security film specification type SH8CLARL applied to both surfaces, post installation of the doors into Cars. Film shall be applied to intercar access door windows by 3M licensed installers only. Film shall be pre-cut to exact sizes by installers using Computer Numerically Controlled cutting techniques. Detailed trimming of film in-situ will not form part of the application process. Film application methods shall be designed to facilitate ease of future replacement.</u>
---------------	---

6.7.3.1 *Wheelchair Access*

The intercar access and controls shall comply with DSAPT for access paths and with AS1428.1.

The intercar door controls shall be located between 900 mm and 1100 mm Above Floor Level. The control shall have a minimum diameter of 30 mm, be colour contrasted, backlit and require no more than 15 N force to operate.

6.7.3.2 *Minimum Access Width and Height*

The minimum unobstructed intercar access from one Car to the adjacent Car shall be 1350 mm horizontally and 1950 mm vertically.

6.7.3.3 *Intercar Door Visibility*

RFTA 00359	<u>The intercar doors shall include windows with clear section of at least 1.5 m<sup>2</sup> per doorway through the interconnection into the adjacent Car when closed. These windows shall be constructed of laminated glass conforming with Australian Standard AS 2080. However, in the event that alternate access panels kick-out panels are fitted for emergency egress the area of the clear section shall be maximised to the extent permitted by the presence of the alternate access panels kick-out panels. Intercar access systems which provide larger unobstructed visibility between Cars are considered highly desirable to improve Passenger and Guard security.</u>
---------------	---

The alternate access panels shall not be in the glazed section of the intercar doors.

To minimise the risk of loss and /or damage to the alternate access panel, the surrounding door leaf and car interior, the alternate access panel shall not detach from the door leaf i.e. use of a fixed hinge or similar.

Once opened it shall take no longer than 5 seconds to reset each alternate access panel to the closed and locked position. Closing and locking the alternate access panel shall cancel the TOS indication and show as an event on the Event Recorder log.

When opened the alternate access panel shall maximise the available evacuation path consistent with the constraints of the door leaf structure and surrounding car interior.

The alternate access panel locking system shall be covered by flush fitting tear away decals to prevent accidental operation and to reduce the likelihood of abuse by vandalism.

A 50mm thick safety yellow (AS2700 Y15 “Sunflower”) stripe shall be applied on the inside of each Passenger intercar door adjacent to the rubber joining seal from top to bottom and the intercar door frame shall be colour contrasted.



#### 6.7.3.4 Fire Protection

When closed, the intercar doors and the surrounding end of the Car construction shall provide smoke and fire protection to the minimum standard of integrity of 20 minutes when measured in accordance with AS1530 Part 4. This time rating shall apply across the full intercar interface i.e. each door set shall have a minimum standard of integrity of 10 minutes when measured in accordance with AS1530 Part 4.

RFTA  
00359 Emergency egress through the intercar doors shall be provided (by means of ~~alternate access panels~~ ~~kick out panels~~ ~~or alternative~~ and door release controls). This shall be available when locked, and shall be reported on the TOS and Event Recorder:

- a) if locked; and
- b) if activated.

#### 6.7.3.5 Intercar Door Operating Times

The powered opening time of the doors shall be adjustable between 3 and 6 seconds. Doors shall remain in the open state after powered opening for a period adjustable between 5 and 15 seconds. The powered closing time of the doors shall be adjustable between 4 and 10 seconds. The door timing shall be adjustable in future at no cost to RailCorp.

#### 6.7.3.6 Intercar Door Obstruction Detection

The intercar doors shall be fitted with an obstruction detection system to reopen the doors in the event of a person or object being caught. Door opening controls and EDR shall be provided in the intercar gangway between intercar doors.

PPP Co shall provide calculations to show that the intercar doors meet the same injury avoidance requirement as for bodyside Passenger doors.

#### 6.7.3.7 Intercar Door Closing Force

The door closing Effective Force shall be no greater than 80 N throughout the complete closing sequence. The door closing Peak Force shall be no greater than 160 N at any time during the door closing cycle.

#### 6.7.3.8 Intercar Doors Locked Open

The intercar doors shall be able to be locked in the open or closed state by authorised personnel. The locking facility shall be provided at each intercar gangway location, as well as at the Active Guard's Workstation.

Intercar doors, which have been locked open, shall be able to be closed either locally at the respective gangway location and/or from an Active Guard's Workstation and/or automatically through an activated fire detection system. Once released the doors shall automatically close with the obstruction/detection system active.

Controls shall be provided on both Cars at the Car end and these shall operate the intercar doors on both Cars.

#### 6.7.3.9 Operation of intercar door in the event of Set roll over

In the event that the Set has rolled onto its side or roof it shall be possible to open the doors manually and for the doors to remain in the open position.

#### 6.7.3.10 Intercar Door Strength

RFTA  
00040 Intercar doors (including windows and operating mechanisms) shall be capable of meeting the loading requirements of section 5.6 of Railway Group Standard GM/RT 2457. In addition, they shall be capable of withstanding a ~~40g~~ 5g self-weight acceleration in any direction, and shall remain openable following collisions at speeds up ~~55 km/h~~ to the maximum closing speed as referenced in TPS Clause 6.8.2 [as modified by RFTA00012].

6.7.4 Crew Bodyside Access Doors

The Crew bodyside door shall provide direct access or egress from the Crew Cab on both sides of the Car, during all modes of operation.

Crew and authorised staff, such as Presentation Staff shall be able to unlock and operate the Crew bodyside doors whilst standing at either the platform level, rail level or below rail level. A keyed method of locking and unlocking the Crew bodyside door from the outside shall be provided as described in clause 3.5.1.

6.7.4.1 Doorway Dimensions

RFTA  
00225

The Crew bodyside door clear opening shall be not less than 1930 mm high x ~~650~~ 630 mm wide between handholds, but once inside the Crew compartment the head height shall be a minimum of 1950mm.

6.7.4.2 Door Operation

The doors shall be able to be individually locked open during running up to a set speed of up to and including 70 km/h. The state of an open door shall be alerted to the Driver at speeds in excess of 70 km/h. An audible alert shall be provided at the door location as the door closes when the set speed is reached. The speed setting shall be adjustable on demand by and at no cost to RailCorp to any value from 70 km/hr to zero. Alteration of the speed setting shall not be possible by Crew but only level 3 authorised personnel. Isolation of any doors and their locking in the open position shall be recorded on the Event Recorder.

6.7.4.3 Emergency Manual Operation

RFTA  
00022

The Crew Cab bodyside door EDRs shall function as described in Clause 6.7.2.3 Door Emergency Operation. Additionally they shall function as described below.

~~The internal Crew Cab bodyside door EDRs shall have the same functionality as the internal Passenger bodyside door EDRs.~~

~~The external Crew Cab bodyside door EDRs shall be fitted with Access 1 Security level locks and shall have the same functionality as the external Passenger bodyside door EDRs.~~

6.7.4.3.1 Internal Crew Cab Bodyside Door EDRs

Internal Crew Cab bodyside door EDRs shall be unavailable for operation once the vehicle speed exceeds 5 km/h.

The Crew shall be alerted at an EDR Stage 2 Activation only.

RFTA  
00198

Stage 2 Activation of the EDR control shall be recorded in TOS and in the event recorder.

6.7.4.3.2 External Crew Cab Bodyside Door EDRs

External EDRs shall be accessible from both the platform and when standing at track level.

RFTA  
00022

External Crew Cab bodyside EDRs shall be unavailable for operation once the vehicle speed exceeds 5 km/h.

In addition to being located next to the door they operate, EDR controls shall not be covered by the opening of any door.

The external Crew Cab bodyside door EDR sealing devices shall be fitted with Access 1 Security level locks.

RFTA  
00198

---

The external Crew Cab bodyside door EDRs shall continue to function even when the Set is in Stabled state.

The Crew shall be alerted at an EDR Stage 2 Activation only.

Stage 2 Activation of the EDR control shall be recorded in TOS and in the event recorder.

#### 6.7.4.4 Crew Door Operation

The door opening and closing times shall be nominally set at 3 seconds. This timing shall be adjusted and, once accepted by RailCorp during user trials, set for all Cars by PPP Co at no additional expense to RailCorp. The door timing shall be adjustable in future at no cost to RailCorp.

#### 6.7.4.5 Crew Door Closing Force

The door closing Effective Force shall be no more than 160 N throughout its complete closing sequence. The door closing Peak Force shall be no greater than 240 N at any time during the door closing cycle.

#### 6.7.4.6 Crew Door Short Cycling

During the closing of the door, the Crew shall be able to cause the door to open by operating the "Door Open" command. Under these conditions the door shall immediately begin to re-open except where the train speed has exceeded the set speed. The doors system shall not suffer degradation as a result of this short cycling.

During the opening of the door, the Crew shall be able to cause the door to close by operating the "Door Close" command. Under these conditions the door shall immediately begin to re-close. The doors system shall not suffer degradation as a result of this short cycling.

#### 6.7.4.7 Emergency Power Closing

The doors shall be provided with an emergency power closing speed that shall rapidly close the doors. The door closing speed shall be adjustable in future at no cost to RailCorp.

#### 6.7.4.8 Crew bodyside access door strength

The Crew bodyside access doors shall meet the same structural strength requirements, and be subject to the same testing regime, as the Passenger bodyside doors.

#### 6.7.4.9 Crew bodyside access door obstruction detection

The Crew bodyside access doors shall be fitted with a door edge rubber to buffer the effect of an impact with a person on closing.

The doors shall incorporate door obstruction detection that will detect an obstruction as small as 15 mm width.

Each doorway shall be fitted with an automatic re-opening facility. On detection of an obstruction the doors shall behave as follows:

##### a) Normal operation

If, during the first attempt to close, a door senses the presence of an obstruction, the door shall re-open by at least 100mm before attempting to close again.

If, during the second attempt to close, the door senses the presence of an obstruction, the door shall re-open by at least 100mm before attempting to close again.

If, during the third attempt to close, a door senses the presence of an obstruction, the door shall re-open by at least 100mm and remain in this state until reset.

##### b) Closing initiated by Set speed (as described in clause 6.7.4.2)

If, during the first attempt to close, a door senses the presence of an obstruction, the door shall remain in that state for two seconds before attempting to continue closing.

If, during the attempt to continue closing, a door senses the presence of an obstruction, the door shall attempt to continue closing for two minutes before ceasing to attempt closing. The door shall remain in this state until reset.

c) Closing initiated by emergency power closing (as described in clause 6.7.4.7)

If, during the attempt to close, a door senses the presence of an obstruction, the door shall attempt to continue closing for two minutes before ceasing to attempt closing. The door shall remain in this state until reset.

To reset the door, the Crew shall operate the Crew bodyside access door close control to restart the closing cycle.

6.7.5 Crew Transverse Doors

RFTA  
00234

Access to the Crew Cab area shall be provided from the Passenger area by a transverse door 1930mm high and a free portal width of at least 700mm and an effective clear opening width of at least 700mm fitted with a suitable Emergency Door Release to allow terminal end detrainment in case of staff incapacitation. The door shall lock when moved to the closed position.

The Crew transverse door shall be able to be opened under the design extremes of Car body shell twist.

6.7.5.1 Emergency Egress

The Crew transverse door shall provide emergency egress for the Crew between Crew Cab and Passenger area and for Passenger egress from the Saloon to the terminal end access ramp. The door shall be outwardly swinging (i.e. swinging into the Passenger area) hinged on the right looking from the Cab, and shall be fitted with a large push bar type quick release door handle on the Cab area side. The force required to operate the push bar shall be no more than 19.5 N. Passenger throughput shall be equivalent to or better than the detrainment rate over the detrainment ramp.

6.7.5.2 Security

The Crew transverse door shall provide security against unauthorised access between the Passenger Vestibule and the Crew Cab. The Crew transverse door shall provide security for the Cab area from potential intruders. The door, its handles, shutter, window, fixings and installation shall be designed to the requirements of AS 5039.

6.7.5.3 Crew Transverse Door Window

The Crew transverse door window shall provide clear visibility between the Crew Cab and the Passenger area for the Crew and Passengers. The door shall be fitted with a laminated toughened safety glass window conforming with Australian Standard AS 2080 and be no less than 10.2 mm thickness. The glass window shall have its bottom edge 1100 mm Above Floor Level and be as large as is structurally possible.

The Crew transverse door window shall be fitted with a shutter or similar, controlled from the Crew Cab. Such a shutter shall effectively obscure vision into the Crew Cab from the Passenger area and prevent light from the Passenger area entering the Cab. In the open position, the window shall be exposed to ensure visibility of the Cab area to the Passengers. The shutter shall be able to be placed in any position and remain unchanged during all Set operations. A means shall be provided to secure the shutter in the closed position. The design shall be rattle free. Means shall be provided to ensure that only Maintenance Staff are able to remove the sliding shutter and glass.

RFTA  
00322

Crew transverse door windows shall have 3M safety and security film specification type SH8CLARL applied to the surface facing into the Car, post installation of the windows into Cars. Film shall be applied to crew transverse door windows by 3M licensed installers only. Film shall be pre-cut to exact sizes by installers using Computer Numerically Controlled cutting techniques. Detailed trimming of film in-situ will not form part of the application process. Film application methods shall be designed to facilitate ease of future replacement.

#### 6.7.5.4 Self Closing

The Crew transverse doors shall be self-closing, but capable of being latched in the fully open position for cleaning or emergency access. It shall not be possible for vandals to misuse such latching to disrupt the normal operation of the door.

#### 6.7.5.5 Noise Barrier

The Crew Cab transverse door and its sealing together with the end wall assembly shall form an effective noise barrier, such that train generated and Passenger generated noise does not affect the Crew. This barrier shall provide a 25 dB(A) attenuation when tested with the door closed and using a noise source to simulate Passenger noise. For the purposes of noise level testing a noise source shall be placed in the Vestibule simulating Passenger noise.

#### 6.7.5.6 Crew Transverse Door Strength

Crew transverse doors (including windows and operating mechanisms) shall be capable of meeting the loading requirements of section 5.6 of Railway Group Standard GM/RT 2457. In addition, they shall be capable of withstanding a 40g ~~5g~~ self-weight acceleration in any direction, and shall remain openable following collisions at speeds up to ~~55 km/h~~ to the maximum closing speed as referenced in TPS Clause 6.8.2 [as modified by RFTA00012].

RFTA  
00040

#### 6.7.5.7 Fire Protection

When closed, the Crew transverse doors and the surrounding end of the Car construction shall provide smoke and fire protection to the minimum standard of integrity of 10 minutes when measured in accordance with AS1530 Part 4. Where the Crew transverse door is not located at the end of a Car this requirement shall apply only to the door and not to the surrounding Car construction.

#### 6.7.6 Terminal End Emergency Access

The terminal end emergency access door and the Crew transverse door shall provide emergency egress of Passengers and Crew through the ends of each Set to track level at a rate of at least 1200 able Passengers in a ten minute period using both ends of the Set. The end detrainment door and ramp arrangement must have the capability to detrain Passengers Set to Set and to detrain Passengers to track level (but not both at the same time).

There shall be capability to detrain Passengers safely to ground level via the emergency access ramp, to ground level using trackside emergency stairs, and between the Set and existing RailCorp cars.

Provision shall be made to secure the terminal end emergency access door in the open position to prevent accidental closure when subject to operation and environmental factors. The terminal end emergency door shall comply with the requirements of clause 4.5 above.

##### 6.7.6.1 Access Ramp

An emergency access ramp shall be installed at each terminal end emergency egress from the Driver's Cab.

It shall be deployable from the inside without the need to exit the Cab. It shall be deployable by one person in anthropometric data range of 5% female to 97.5% male.

The emergency access ramp shall be secured using a suitable Emergency Door Release.

The emergency access ramp shall provide some form of guide rail in the deployed position, anti slip surfaces, retro-reflective edging and end delineation, lighting on deployment at foot level and surrounds, and a step from the outer end to sleeper level of not greater than 250 mm for all track configurations.

The emergency access ramp length and width shall be maximised while taking into account other key Car end design parameters, including location and layout of Crew Workstations, crashworthiness, and Driver sightlines.

#### 6.7.6.2 Instructions

The emergency access system shall include notices on the inside and outside of the Set giving directions on how the system is to be deployed.

#### 6.7.6.3 Environmental

The emergency access ramp shall be sealed against air and water leaks, when in the secured position, even after multiple uses.

The emergency access ramp shall not obscure in any way the specified external visibility for the Crew detailed in Appendix T – Crew Visibility.

#### 6.7.6.4 Track Side Emergency Stairs

The terminal end emergency door step shall integrate with the CityRail emergency stairs as shown in RailCorp drawings CV0322308 and CV0322309 to provide train-to-track-level access. Train-to-track-level access shall be available using either the trackside emergency stairs or the emergency access ramp, but not both at the same time.

#### 6.7.6.5 Access Configuration

There should be no obstruction or step at or Above Floor Level. The emergency access ramp shall allow the through movement of a Passenger on a stretcher.

#### 6.7.6.6 Time to Deploy Emergency Access

The emergency access ramp shall be capable of being fully deployed by any non-trained person within two minutes, including all necessary safety restraints. Instructions on operation shall be provided, clearly indicated and visible at all stages of deploying the ramp.

#### 6.7.6.7 Re-configuration of Emergency Access

It shall be possible to re-configure the emergency access ramp to make the Set fully operational within ten minutes by one trained person and one untrained person.

#### 6.7.7 Interface to Set Subsystems

The Doors and emergency egress devices shall interface with the following Set Subsystems:

- a) Traction;
- b) Braking;
- c) Train Operating System (TOS);
- d) Communications – details of the door-warning device are covered in clause 11.7 (Door Warning Device) of this RailCorp Train Performance Specification; and
- e) Event Recorder.

##### 6.7.7.1 Interface to Traction

Operation of the Set at above the speed set under clause 6.7.4.2 (Door Operation) of this RailCorp Train Performance Specification with one or more of the Crew Cab bodyside doors open, partially open or unlocked shall automatically cause body side doors to close and lock. An audible warning shall sound in the Crew Cab with the open door to warn the Crew of the door closure.

~~Deployment of the end detrainment ramp shall disable traction.~~

##### 6.7.7.2 Interface to TOS

An indication shall be provided on the TOS screen to the Driver and via a distinctive audible alarm in all Crew Cabs if any Crew Cab side door is open, opened or unlocked above the set speed point under clause

6.7.4.2 (Door Operation) of this RailCorp Train Performance Specification or in the wash speed mode or is subject to unauthorised opening. Such indication on the TOS shall include the location of the door.

Where an alarm regarding door status is given but not corrected, acknowledged or the door status otherwise rectified, then the TOS shall display a continuous visual warning to the Driver. This warning shall include a notification of the maximum speed of Set operation allowed.

All Passenger access door Failures including those in the following list are to be recorded by the TOS and indicated to the Crew as a "Door Failure":

- a) Fail to open;
- b) Fail to close;
- c) Fail to lock;
- d) Slow to open > 20% over the specified time requirement;
- e) Slow to close > 20% over the specified time requirement;
- f) Door obstructed;
- g) Door isolated other than Nightsafe;
- h) Fail to de – isolate;
- i) Fail to unlock; and
- j) Other faults including general access system performance degradation shall be monitored by the TOS and recorded for maintenance purposes but not indicated to the Crew.

6.7.7.3 *Interface to TOS - Security*

An indication shall be provided on the Driver's Workstation and Guard's Workstation to indicate if any non-active Crew Cab transverse door is open or is subject to tampering. Such indication shall include the location of the door.

6.7.7.4 *Advice of Deployment to TOS*

Any partial or full deployment of the emergency access door shall be advised to the Crew and recorded by the TOS.

6.7.7.5 *Interface to Braking*

~~Not Used~~ Deployment of the end detrainment ramp shall cause the Emergency Brake to be applied.

6.7.8 *Front End Access for Cleaning*

The design of the Set shall give consideration to the method employed to manually clean the front of the Set, including the front windscreens and provide maintenance access.

RFTA  
00260

**6.8 Crashworthiness**

6.8.1 Risk assessment

PPP Co shall carry out a full risk assessment of the rolling stock and its operating environment. On the basis of the risks identified the Set shall include crashworthiness provisions to reduce the risk to Passengers and Crew to levels consistent with or better than a Set built to UK Railway Group Standard GM/RT2100 or equivalent, and with maximum peak forces corresponding to the decelerations in Table 7 below:

Duration of acceleration pulse	Deceleration
< 5 ms	Unlimited
5 – 150 ms	Deceleration shall be within the revised limits bounding the acceleration-time corridor shown in Figure 38, section 2.5.8, of the Safetrain Project Final Technical Report BRPR-CT97_0457
> 150 ms	5g maximum

**Table 7: Maximum peak forces**

The risk assessment shall be carried out in line with the provisions of the Contract Management Requirements.

6.8.2 Equivalent Collision Performance

In a head on collision, the Set shall perform in an equivalent or safer manner to that of how a two four-Car trains coupled as an eight-car train that performs in a collision with a stationary similar train as set out in Table 8a below. The design and shall maximise the energy absorbing capacity of sacrificial elements in the couplers before crumple zones.

Collision Speed Range	Accepted Damage	Energy Absorbed by
Up to 15 km/h	None	Couplers
From 15 to 19 km/h	Coupler sacrificial elements on first two Cars	Couplers
From 19 to 24 km/h	Coupler sacrificial elements	Couplers
From 24 to 42 km/h	Couplers and crumple zones	Couplers and crumple zones
Above 42 km/h	Couplers, crumple zones and Car body shells	Couplers, crumple zones and Car body shells

**Table 8a: Performance of two four-Car trains coupled as an eight-Car train in collision with a similar train.**

Note, Table 8b is supplied below for reference to describe the equivalent performance of a single four-Car train colliding with a similar train, for traceability to previous RailCorp 4-car train collision performance levels.

Collision Speed Range	Accepted Damage	Energy Absorbed by
Up to 15 km/h	None	Couplers

RFTA  
00012



From 15 to 19 km/h	Coupler sacrificial elements on first two Cars	Couplers
From 19 to 24 km/h	Coupler sacrificial elements	Couplers
From 24 to 55 km/h	Couplers and crumple zones	Couplers and crumple zones
Above 55 km/h	Couplers, crumple zones and Car body shells	Couplers, crumple zones and Car body shells

RFTA  
00012

**Table 8b: Performance of a Four Car Train in Collision with Similar Train**

6.8.3 Door Operation

It shall remain possible to open any door that is not within part of the Car that experiences distortion as a result of a collision. If required by RailCorp, PPP Co shall provide a means for Passengers to move through any of the intercar doors and Emergency Doors (such as alternate access panels ~~a kick-out panels~~) in the event of it not being possible to open the doors. If alternate access panels ~~kick-out panels~~ are provided then any disturbance of the panel from its locked position shall be indicated to the crew by audible warning, CCTV and TOS indication and shall be logged on the Event Recorder.

RFTA  
00359

6.8.4 Offset Angled Collisions

In an offset collision at a small angular difference of up to 4.5° (equivalent to a collision between two similar trains at 9°) the performance of the Set shall not be more than 10% different from an in-line collision.

In collisions where two trains are not aligned to enable the couplers and anti-climbers to fully engage PPP Co shall consider the inclusion of additional Lateral members at Sole Bar and Cant Rail levels to provide improved offset angled collision resistance. During the design process PPP Co shall propose the required strength for these members for acceptance by RailCorp based on the collision scenarios identified in its risk assessment.

6.8.5 Anti-climbers and Car Body Integrity

The Car shall be fitted with anti-climbers as shown in Appendix G – Anti-Climbers. Anti-climbers between Cars shall remain effective with a vertical offset of up to 100 mm.

The design of the Cars shall mitigate risks of loss of vehicle integrity and vehicle overriding. The design shall adopt standard repairable elements for the couplers and crumple zones with the intent of minimising collision repair costs.

6.8.6 Collision Damage and Repair

In the event of a low speed collision the Set shall be designed to minimise the time and cost to repair damage. PPP Co shall include collision repair cost and time in its risk assessment and justify design choices to RailCorp on the basis of whole of life cost.

6.8.7 Roll Over Strength

The structure of the Car shall prevent significant deformation of the normally occupied space of the Passenger and Crew areas of the Car in the event it rolls on its side or roof. The structure shall support twice its dead weight whilst resting on its side or roof. This is to be demonstrated by PPP Co with FEA analysis during the design process as required in Appendix E – FEA and Fatigue Life Evaluation.

**6.9 Fire Performance**

The Set shall provide the Crew with the necessary equipment to carry out the first line of action in the event of a fire caused by vandals or faulty equipment. The necessary equipment shall consist of the fire extinguishers as specified in Clause 6.9.1 of this Train Performance Specification, and any other equipment as identified by the fire risk assessment as described below.

RFTA  
00147

RFTA  
00148

The emergency equipment shall be located so that it ~~is not exposed to heat or other influences likely to cause does not suffer~~ degradation of the emergency equipment from heat or other environmental exposure.

PPP Co shall engage an independent and competent third party with expertise in rail fire safety, risk assessment, fire engineering analysis and materials performance to undertake a fire risk assessment consistent with standards and state-of-the-art. This risk assessment shall:

- a) be carried out against standards proposed by PPP Co and agreed by RailCorp;
- b) use hazard information to develop appropriate fire scenarios for evaluation;
- c) utilise fire engineering analysis, modelling and test results to determine likely consequences of fire for each scenario in terms of the fire safety goals for the rolling stock;
- d) quantify fire risk for Passengers/staff and other fire safety goals using a QRA methodology; and
- e) demonstrate that the fire risk meets acceptable Australian and international risk criteria.

In parallel with this work, testing programs shall be used to generate appropriate material fire safety data to be included in the fire engineering analysis and overall fire risk assessment.

For the purposes of the analysis of fire performance, including the fire engineering analysis and the fire risk assessment, the Set shall be considered to be a Category 1b train as defined in BS6853.

All fire tests conducted in support of alternative materials shall be scientifically well founded and repeatable, shall generate appropriate performance data, and shall take into account the contribution that each material makes to the overall fire hazard.

#### 6.9.1 Fire Extinguishers

A fire extinguisher shall be provided in each Car. On the Cars without a Cab it shall be locked in a cabinet. Each extinguisher shall be restrained to prevent damage or accidental operation of the extinguisher. For familiarity, the Fire extinguishers provided shall be of a similar type and with a similar mounting technique as the fire extinguishers used on the most recent CityRail fleet.

The fire extinguishers used on the most recent CityRail fleet are as follows:

Supplier: Bulbecks Fire Industries (BFI)

Part no.: FP 90 ABE

Model no.: FEX 133-MS-090-AS

Capacity: 9kg.

#### 6.9.2 Fire Resistance and Toxicity

Materials used in the Set shall be, wherever possible, fire-retardant in accordance with RailCorp's Specification FE 103. Materials in this case refer to all those internal to the Car including all internal and external seat, wall, floor, ceiling and insulation materials as well as any materials including paint and finishes that may be a hazard to Passengers or staff in a fire or smoke situation. The use of any non-fire retardant material requires RailCorp's prior approval.

A peak fire heat release rate shall be calculated for each Car type and shall not exceed 30MW. The peak fire heat release rate shall be the maximum of the summed rates for each material at each point in time during the combustion of each material, based on the theoretical assumption that all materials burn simultaneously, with each material burning at the maximum heat release rate for that material (the "Duggan method").

The heat release rate shall be generally derived in accordance with AS 3837 cone calorimeter method with the specific test to be agreed with the RailCorp. All exposed interior materials shall be considered; however, for the peak fire heat release calculation only, a material which, in total, makes up less than 0.7 square metres of total surface area within a car type, may be exempted from the calculation, subject to agreement by RailCorp. The final peak fire heat release rate calculation shall be submitted for review by RailCorp at CDR.

Toxicity shall be measured in accordance with the requirements of NF X 70-100. An acceptable level of toxicity per Car volume for each gas measured under NF X 70-100 shall be established in accordance with the general requirements of BS 6853.

## **6.10 Fire Detection**

### **6.10.1 Fire Detection**

The Set shall have a fire detection system. This shall be capable of detecting a fire in any Passenger or Crew compartment.

On detection of a possible fire by means of smoke detection the system shall have two levels of response that shall indicate the Car involved, the level and the location to within less than 8m (measured Longitudinally) within the Car that the possible fire is located. The two levels of alarm are:

- a) First alarm: Sent to the Crew indicating that a fire may have started and that this is a first stage alarm. The first stage alarm may be suppressed if required by RailCorp; and
- b) Second alarm: If the detection system detects a larger heat source or denser smoke it shall send a further alarm to the Crew indicating that this is a second stage alarm.

In the event of detection of a fire the HVAC system shall be controlled to minimise the spread of fire and promote the escape of Passengers.

In the event of detection of smoke outside the Set an alarm shall be provided to the Crew. The Driver shall then be able to remotely close the HVAC fresh air intake dampers for the Set.

## **6.11 Cleanliness, Vandalism and Graffiti**

### **6.11.1 Cleaning Materials**

Information on all cleaning materials and their use shall be provided to RailCorp. RailCorp prefers the use of cleaning materials that are already included in the cleaning materials currently being used.

### **6.11.2 Wash Plant**

The Set shall be compatible with RailCorp's existing wash plant facilities, as defined in Appendix B – Washplant Facilities. The Set shall be capable of being driven, pushed or pulled through the wash plant without detrimental effects to the Set or the Crew. The Crew shall be able to perform this function without leaving the Crew Cab. Any equipment to be isolated shall be done automatically via selection of the wash speed control.

### **6.11.3 Vandalism and Graffiti**

The Set shall be designed and manufactured to be Vandal resistant and facilitate the rapid remediation, repair and restoration and in-service maintenance of any Vandalism and Graffiti incidents. The level of Vandalism and Graffiti resistance of each component shall be considered as a major aspect of its design and will be assessed during the Technical Review process.

All windows, including the glass and/or frame shall be designed to prevent removal by unauthorised persons.

All exposed fasteners accessible in Passenger areas and the Crew Cabs including screws, nuts and bolts shall be of a tamper-proof, security fastener design.

All controls shall be robust, of industrial quality and resist physical abuse, Vandalism and unauthorised removal. All controls shall have an IP rating of 54, except for the Power/Brake Controller (see clause 7.3.3.3).

Particular attention shall be given to the method of attachment of any buttons, covers, globes, control actuators, handles or knobs to prevent removal except by Maintenance Staff with specialised tools. Clips, screw-on and adhesive methods of attachment shall not be used.

All surfaces subject to potential Graffiti attack shall be of a highly Graffiti resistant type, or be protected by acceptable Graffiti resistant coating.

**6.12 Corporate Information and Advertising**

PPP Co shall develop an overall sign scheme that shall provide signs similar to those currently provided on RailCorp’s existing fleet. This scheme shall comply with RailCorp’s “Safety Signage Standards and Design Guidelines for Passenger Rolling Stock” and shall be similar in content, size and quantity to the following RailCorp drawings as listed below:

0-66-00186	3-66-00140	3-66-01649	4-66-00159
0-66-01824	3-66-00144	3-66-01650	4-66-00161
3-66-00068	3-66-00163	3-66-01652	4-66-00162
3-66-00138	3-66-00182	3-66-01700	4-66-00164
3-66-00139	3-66-00204	3-66-01822	

An additional sign “Ensure a firm hold when entering and exiting Cab” to Drawing 3-66-01822 shall be fitted in a prominent location for viewing when entering the Cab from track level. Additional signs may be required by RailCorp.

RFTA  
00119

The CityRail network map is approximately size 800 mm wide x 800 mm high. At least two spaces for CityRail Network Maps such maps shall be provided in the seating areas at the Car ends. These shall be large enough to fit, as a minimum, the dimensions of a 0-66-01824 map as defined in Table 9 below.

Other typical network maps are used by RailCorp and may be suitable for fitment including the maps as listed in Table 9 below:

0-66-01824	430 mm wide x 610 mm high
0-66-01826 (integrated sign)	765 mm wide x 765 mm high
0-66-01827 (integrated sign)	765 mm wide x 765 mm high

**Table 9: RailCorp Route Maps**

No network maps are to be fitted to the ceiling above stairways.

Where the structure of the new Set varies significantly from those shown in EI 166 or as otherwise specified the location of signage shall be determined by consultation with RailCorp.

Signage shall be Vandal, Graffiti and Graffiti cleaner resistant.

The Rolling Stock Manufacturer may affix a simple, unobtrusive nameplate including the year of acceptance of the Car on or adjacent to two diagonally opposite doorsills of each Car.

An area shall be reserved for the date of manufacture, and later overhaul, to be marked or painted.

**6.12.1 Emergency Signs**

Emergency signs shall be fitted throughout the Set. These signs shall be photo luminescent. The route to the nearest emergency exit shall be indicated by low-level emergency signs on the sides of transverse seats and elsewhere as required by RailCorp.

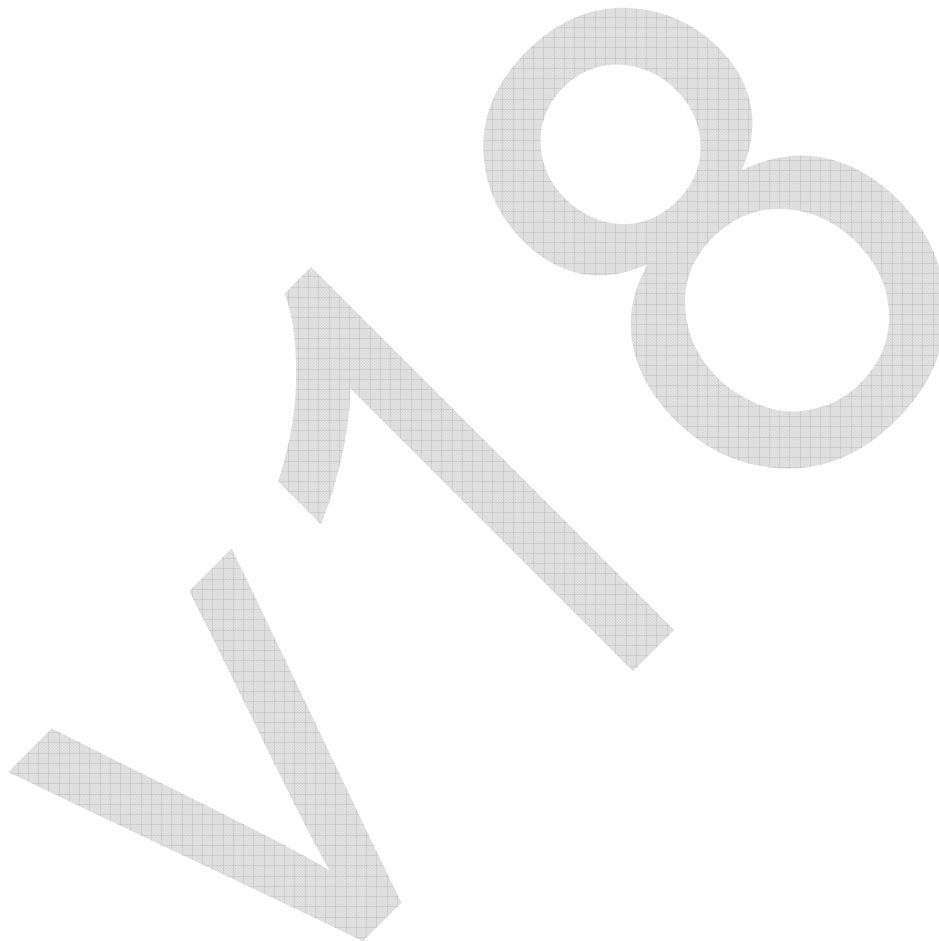
6.12.2 Accessibility Signs

Wall space internally and externally shall be provided for access signage in line with DSAPT. Signage shall be provided in English sentence case.

6.12.3 Passenger Door Identification Numbering

To enable correct identification of passenger door leaves, decal numbers are to be attached near the external and internal side of all passenger door leaves as identified in RailCorp Engineering Modification EM 5543 Version 1.0 (for the Millennium fleet). The exact location of the door identification numbers is to be agreed with RailCorp as part of the overall sign scheme.

RFTA  
00352



**7 Train Crew Requirements**

Without limiting clause 10.3 of the Conditions of Contract the design of Crew areas, controls, equipment and access shall be derived through consultation with RailCorp and based on the following:

- a) NSW Occupational Health and Safety Regulations (as set out in Clause 10.3 – Occupational Health and Safety) of the Conditions of Contract;
- b) RailCorp specified requirements;
- c) Established railway international or national best practices;
- d) Railway specific national and international ergonomics & human factors standards; and
- e) Non railway specific national and international ergonomics & human factors standards.

To prevent any day and night time glare in the Crew working areas all material used in the Crew areas shall be matt finished or glare free.

All items in the Cab supplied by PPP Co and for which stowage is to be provided for by PPP Co shall be retained including in roll over scenarios.

An independent expert in ergonomic design shall be engaged by PPP Co to work with RailCorp to develop the Crew facilities design.

Within this specification requirements for Crew Cabs shall also apply to both Driver's Cabs and Guard's Cabs.

Letter  
RC00273

**7.1 The Driver's Cab**

The Cab area shall be designed to allow up to 4 people simultaneously in the Cab at any one time, without causing disruption to the normal duties of the Driver or Guard. The useable area in which persons can stand shall not be less than 3.5 m<sup>2</sup>.

The cab layout shall, as close as is practicable, follow the diagrams shown in Appendix H – Cab Layout and Appendix R – Control Switch Panels and also meet the requirements of this RailCorp Train Performance Specification.

Unless PPP Co can demonstrate a significant benefit for the change the Cab layout shall retain as a minimum:

- a) the relative locations of the different functional groups of equipment;
- b) the relative location of the controls within each group;
- c) the current type of control; and
- d) the current functionality of existing controls.

7.1.1 Not used

7.1.2 Driver Location

The driving position shall be located to the left of the Car centreline. The seats and Driver controls shall be fitted in such a way that they shall allow the Driver to operate the Set in a seated or standing position while providing a line of sight as defined in Appendix T – Crew Visibility.

7.1.3 Guard Position in Driver's Cab

A Guard's Workstation in the Driver's Cab shall be provided to the right hand side of the Cab and organised in such a manner that regular movements to the side doors can be completed without interfering with the Driver's Workstation. This configuration shall allow both Driver and Guard to work in their respective workstation simultaneously without conflict. An authorised person seated at a Workstation in a Crew Cab shall be able to observe the other Workstation in the same Crew Cab and the actions of its occupant.

7.1.4 Crew Seats

Seats shall be provided for the Driver and Guard. The Guard's seat shall be located such that the Guard may use the seat whilst working at the Guard's Station. Seats shall be provided with lumbar support and vertical shock damping.

RFTA  
00333

7.1.5 Crew Seat Adjustments

The parameters of the Crew seats that shall be adjustable include the following:

- a) lumbar support, unless agreed otherwise by RailCorp;
- b) ~~vertical shock damping (ride level); not used;~~
- c) seat height;
- d) seat back tilt;
- e) fore and aft travel;
- f) raiseable arm rests; and
- g) ~~compensation for Crew weight and height not used.~~

RFTA  
00333

The seats shall be capable of facing either the forward, side-on or reverse direction.

7.1.6 Storage Areas

An area for stowing Crew bags and briefcases shall be provided in the near vicinity of the Driver's seat and also in the vicinity of the Guard's Workstation. The space shall allow for accessing the top of the bag measuring approximately 600 mm long x 400 mm high x 200 mm wide.

An extra area for Crew gear such as torches and operating manuals shall be provided within the Crew Cabs.

Areas shall be provided for stowing wheelchair ramps and shall be provided adjacent to all Crew Cabs. The Set shall be compatible with the use of wheelchair ramps complying with AS3856.1. The ramps shall be stored in lockable Bi-Lock cabinets. The cabinet shall be configured to hold the ramp secure and be rattle and noise free. PPP Co shall supply ~~three~~ two wheelchair ramps per Set and each is to be fitted in the wheelchair ramp storage cabinets. ~~The wheelchair ramps to be installed will be provided free issue by RailCorp. The main parts of the ramps shall be made of non-conductive materials and the ramps shall be of the folding type and have the following dimensions when unfolded:~~

Letter  
RC00273

RFTA  
00351

- Trafficable Width: ~~800~~ mm;
- Trafficable Length: ~~1500~~ mm;
- Load capacity: ~~300~~ kg; and
- Maximum Weight: ~~14~~ 10kg.

~~As an alternative to the moveable wheelchair ramp PPP Co may provide a floor mounted ramp that can be deployed by lifting the ramp out from the floor of the door Vestibule. If this approach is adopted then the stowed ramp shall have no protruding parts and shall not cause a trip hazard.~~

7.2 Crew Workstations

7.2.1 Workstation Strength

Each Crew Workstation shall be designed to withstand a 120 kg person standing on the workstation without damage to its panel work or its mounting, or the components that the workstation is mounted or affixed to.

All Crew Workstation and Cab area controls shall be robust, of industrial quality and resist physical abuse and Vandalism.

7.2.2 Workstation Material Electrical Resistance

The Crew Workstations shall be manufactured such that in the presence of an electrical fault the Crew cannot be subjected to electric shock or injury from voltage or current.

### 7.2.3 Active Workstation Indication and multiple Workstation activation

An indication shall be provided on the Driver's and Guard's Workstations to indicate the status of the control station.

If there is an Active Driver's Workstation and/or an Active Guard's Workstation, and another such Workstation and an attempt is made to activate another such Workstation, the Driver and Guard shall be warned of this attempted activation by appropriate visual and audible means to be determined by PPP Co. In such circumstances, the first activated Workstation(s) shall remain active, and the second Workstation shall have no control. An attempt at activating the second Workstation shall highlight that its controls are suspended due to a previously activated Workstation.

If there is an active Guard's Workstation, and a local door control panel is made active, the Guard shall be warned of this activation by appropriate visual and audible means to be determined by PPP Co. In such circumstances, the Guard's Workstation shall remain active, and the local door control panel shall have no control. The local door control panel shall highlight that its controls are suspended due to a previously activated Guard's Workstation.

### 7.2.4 Crew Workstation Design

RFTA  
00089

The Crew Workstation's display and control panels shall be clear, simple to operate, ergonomically designed and Vandal resistant. All control colouring shall be consistent with RailCorp's recent trains.

The Crew Workstation shall be designed and manufactured to be easily cleaned by eliminating crevices, gaps, non-radius corners or joints. Gaps shall be eliminated to prevent food scraps or other foreign objects greater than 1mm diameter from falling into or accumulating within the Crew Workstation, its confines and the equipment.

Desks that extend to the floor shall be fitted with coverings to aid cleaning. The top of the Crew Workstation shall accommodate documents such as opened Timetables or similar books without interfering with the operation of the controls. The Crew Workstation shall be fitted with a restraining lip to ensure documents do not slide off the Crew Workstation.

Within the Crew Workstation there shall be a space for the Diagram Book and a moulded cup holder.

### 7.2.5 Visibility of Crew Cab Controls

Crew Cab controls shall be visible at all times. The brightness of the illumination shall be manually adjustable to ensure that it does not interfere with the Driver's vision particularly at night or in tunnels.

Crew Workstation controls and displays including TOS screens and surveillance monitor shall be suitably screened from externally and internally generated light.

Within the constraints for Crew control sighting essential indicators shall be placed in a 60-degree cone in line with the Driver's normal line of sight when driving the Set. PPP Co shall determine which indicators are essential by consultation with RailCorp staff during the Mock-up phase of the Contract and shall ensure that ergonomic and human factor issues are fully addressed in making this determination.

Indicators shall not show a reflection in a cone of 30 degrees around the horizontal viewing axis of a normally seated, forward facing Driver.

### 7.2.6 Crew Cab Pipes and Conduits

Equipment such as air pipes, conduits, ducts, cabling, terminals and connectors shall be hidden from view and shall not interfere with Crew operations.

### 7.2.7 Driver's Footrest

The Driver's Workstation shall incorporate a powered adjustable Driver's foot rest as specified in RailCorp specification RS SP 05-01-05-01. Clause 6 and clause 8 of RS SP 05-01-05-01 shall not apply. The



---

maintenance support, documentation and other relevant requirements described in the Contract Management Requirements and the RailCorp Through Life Support Specification shall apply.

#### 7.2.8 Double Coat Hooks

Two hinged recessed stainless steel double coat hooks shall be installed in each Cab. The coat hooks shall be located such that when in use (supporting jacket or full length coat), the clothing being supported shall be clear of the floor and not obstruct or interfere with any Cab equipment, visibility or access route.

#### 7.2.9 Circuit Breaker Listing

A Circuit Breaker listing shall be included on the inside of any door or hatch that covers Circuit Breakers. The Circuit Breaker listing shall relate the Circuit Breaker labelling to its function, and the equipment that it isolates. The Circuit Breaker listing shall meet the requirements of FE 116.

### 7.3 Crew Controls

All functions essential to motoring, braking, Passenger door controls, pantograph down and bell shall be hard wired throughout the Set and the Set shall be capable of being operated using these functions.

It shall be impossible to place any Crew control in a mid state position such that the control is not in a position corresponding to a designed state.

No Crew control shall vent compressed air directly into any Crew Cab.

Control features of the Sets shall be similar to those of RailCorp's latest Passenger trains to minimise the requirement for Crew re-training and RailCorp will follow this principle in review of the proposals made by PPP Co.

All sound and light warnings and indications given to the Crew are to be similar to those provided on other trains and clearly differentiable. PPP Co shall base their design of the Sets on an existing train to which access will be provided during the Contract Term and shall ensure that the scheme for noise and visual warnings and indications meets all the requirements of this RailCorp Train Performance Specification.

PPP Co shall minimise the risk of circumvention of any of the controls.

#### 7.3.1 Driver's Controls

The Driver's Workstation shall integrate the TOS and all relevant controls to operate the Set's equipment as set out in Appendix I – Crew Controls standardising the layout as shown in Appendix H – Cab Layout and Appendix R – Control Switch Panels.

#### 7.3.2 Gauges, Switches and Indicators

All gauges, switches and indicators on a Workstation shall be illuminated by the use of backlighting that incorporates brightness control down to zero.

#### 7.3.3 Master Controller

The Master Controller includes:

- a) A Master Control Switch;
- b) A reverser handle; and
- c) A Power/Brake Controller.

The Master Controller shall be configured so that Maintenance Staff can insert and lock into place a disabling key that will physically prevent operation of the Master Controller from that Cab and disable traction command train wires, preventing movement of the train by operation of a Master Controller in another Cab.

7.3.3.1 *Master Control Switch*

The Master Control Switch is key operated using a Master Control Key as shown in drawing 96035 and has two positions, Off and On. It shall not be possible to move the switch to Off unless the reverser handle is in the Isolate position. The key shall be retained in the On position.

7.3.3.2 *Reverser Handle*

The reverser handle shall have four positions Isolate, Reverse, Off and Forward. The reverser is only released when the master control switch is On.

In the Isolate position all train borne systems shall be capable of being operated except the traction system and the release of the Service Set's Park Brakes. The brake controller shall be in the Full Service or Emergency Brake position in order to move the reverser handle either to the Isolate or Off position. The Emergency Brake shall remain operable in the Isolate position.

If the reverser handle is moved out of forward or reverse with the Set speed at above 5 km/h then the Driver Safety System shall be operated causing an immediate Emergency Brake application and the removal of tractive effort. unless the reverser handle is mechanically interlocked to prevent it from being moved away from the forward or reverse position when the Power/Brake Controller is in a traction or braking position (other than Full Service and Emergency Brake),

Only in the Isolate position shall it be possible to turn the Master Control Switch to Off.

7.3.3.3 *Power/Brake Controller*

The Power/Brake Controller shall provide full control over the acceleration, coasting and braking of the Set. When the Master Control Switch is in the Off position, the Power/Brake Controller must be locked out of the traction positions and the braking control shall only be available in the emergency position.

There shall be discrete detents between the functional ranges of emergency brake, service brake, off, and powering. The detents shall help to prevent unwanted movement outside a functional range. The arrangement of detent forces for movement out of the Off/Coast position to either of lowest power level or lowest service brake application shall be such as to avoid overshooting a desired selection of these initial levels.

The exposed surface of the Power/Brake Controller and its surrounds shall be of a durable matt finish and each functional position and/or range shall be clearly marked by raised or engraved letters or an agreed alternative. All control ranges shall be backlit; details of this shall be agreed with RailCorp.

The Power/Brake Controller shall be fitted with an internal splash-proof shroud. The splash-proof shroud shall prevent damage to the Power/Brake Controller and any equipment located below it as a result of spillage of liquids into or on to the Power/Brake Controller.

The controller shall have smooth operation in both powering and braking ranges with ranges to be established by a human factors study and agreed with RailCorp. with equal angular movement allocated to both the powering and Service Braking ranges. The variation of demand levels for powering and braking shall be not less than 7 levels of braking and not less than 15 levels of powering and shall be in distinct steps which shall be logged on the Event Recorder. Each demand level shall not have a detent for its control handle position. The control of traction power shall be arranged as set out in Appendix S - Traction Controller Positions and Power.

The handle shall have a non-metallic covering over the grip area.

The direction of operation shall be forward, towards the front of the Set for braking and backward for power. Without adversely impacting on the control of the Set in traction the angular movement of the traction brake controller in the braking range shall be maximised to ensure that Drivers are able to control enable braking in a smooth and Jerk free manner ~~to stop accurately at stations and signals.~~

RFTA  
00024

RFTA  
00287

RFTA  
00064

The Set must be able to be powered against the Service Brake as a test of braking and tractive effort (power against brake test). The power against brake test shall allow testing at two different levels of brake force to represent normal and Degraded conditions.

7.3.4 Rotary Controls

Unless otherwise specified or approved, any rotary controls shall be capable of continuous bi-directional rotation without incurring damage.

7.3.5 Brake Controls

The Brake Controls provided in each Cab shall include:

- a) Park Brake controls and gauge; and
- b) Emergency Brake Pipe cock and gauge.

7.3.5.1 Driver's Brake Valve Isolating Cock

If required by the braking system design a brake valve isolating cock shall be provided, which isolates the Service Brake control function from the brake system. When isolated, it shall prevent the control of the Service Brakes from that Crew Cab. It shall not prevent the application of the Emergency Brakes.

7.3.5.2 Emergency Brake Pipe Cock and Gauge

The Emergency Brake pipe cock and gauge shall be located on the Cab rear wall between one Crew bodyside door and the Crew transverse door, in a similar position as used on existing CityRail rolling stock. The Emergency Brake pipe cock shall be a non-latching type and shall be closed when the handle is vertical and open when the handle is rotated clockwise to the horizontal position. ~~In the central Guard's Cab the position of the Emergency Brake pipe cock shall be agreed during mock up development.~~

Letter  
RC00273

7.3.6 Park Brake

A means shall be provided in each Crew Cab for authorised staff to control the Park Brakes. This control shall provide an indication of the Park Brake status (on/off).

The Driver shall receive a warning via a flashing indication when any Park Brake is manually applied.

It shall be possible to apply the Park Brake on all Cars at any time. It shall be possible to release the Park Brake on all Cars only when the Driver's controls are cut in and the Brake Pipe is charged above the control governor setting. Local on/off Park Brake controls shall be provided in all Cabs.

7.3.7 Pantograph Control

It shall be possible to raise and lower all pantographs on the Set together from an active Driver's Workstation. A visual indication of the supply potential to raise the pantograph shall be provided and a Fail-safe way to isolate the pantograph, preventing the pantograph from being raised shall be provided. The visual indicator shall be on the pantograph side of the isolating device, not the supply side. The pantograph control shall be located where the possibility of accidental operation is minimised, but shall be readily available for operation in the event of an emergency requirement to drop all pantographs but without stabling the Set.

7.3.8 Windscreen Wiper Control

Windscreen wipers shall be fitted to all forward facing windscreens unless otherwise agreed by RailCorp.

Washers shall be fitted with all wipers.

RFTA  
00045

A single Wiper/Washer control shall be fitted.

The Control shall be Off / intermittent / continuous (two speed slow to fast).

PPP Co shall propose speeds, timing and sweep area taking into account the Driver's area of vision and the size of the windscreen.

All wipers shall be selected by a single 4 position Wiper Selection Switch which shall select the wipers to operate in the following sequence:-

Vertical up - ALL

Horizontal left - Driver's Windscreen

Vertical Down - All

Horizontal right - Guard's Windscreen

PPP Co shall maximise the sweep area of the wiper within the confines of the windscreen.

In the Off position the windscreen wiper shall park in a position that will not impair the Driver's line of sight in all weather conditions. All wipers shall be operated with individual controls determined by consultation with RailCorp staff during the Mock-up phase of the Contract.

#### 7.3.9 Lamp Test

The lamp test push button when activated shall illuminate all indicating lamps in the Cab simultaneously, except those indications that are part of the TOS screen.

#### 7.3.10 Ventilation Control

The Crew control of directional fresh air vents & fresh air control shall provide continuous direction and flow adjustment throughout the range from minimum flow to full flow.

The Cab air conditioning supply vents shall be adjustable by the Crew to blow air in any direction and so that airflow can be directed not to blow directly on the Crew members.

#### 7.3.11 Circuit Breaker location and protection

Circuit Breakers in the Crew Cabs that would normally need to be operated by Crew shall be located such that they can be easily accessible to Crew and shall be protected against accidental activation. Circuit Breakers that would not normally need to be operated by Crew shall be located behind protective panels and PPP Co shall provide viewing panels if required by RailCorp. For Circuit Breakers located outside the Crew Cabs, the design shall optimise the centralisation of all Circuit Breakers.

#### 7.3.12 Brake cylinder pressure gauges

Bogie brake cylinder pressure gauges shall be mounted on either end of the outside of each Car at the Car end to show the brake cylinder pressure in each bogie.

### 7.4 Train Operating System

The Train Operating System (TOS) shall perform data acquisition, data processing, data communication and data presentation functions using modern computer based equipment. A separate Event Recorder shall record Set performance data.

The TOS shall perform Set control functions, generate, acknowledge and diagnose alarms, perform Fault analysis, log Fault occurrences, determine the health of the Set's systems, perform Failure management actions and present information, alarms and Fault conditions to the Set Crew as specified in Appendix K – Train Operating System. The list in Appendix K – Train Operating System constitutes a minimum requirement and this shall be developed by PPP Co during the Contract to take account of all of RailCorp's requirements. All resets of HVAC, doors and communications that are available to the Driver shall also be provided to the Guard.

The Set shall be able to complete a run without an operational TOS. During the course of such a run safety critical alarms shall be transmitted to the Driver and Guard and both shall retain control of safety critical systems.

The TOS shall conduct a train certification test as part of Train Preparation or on request to show that the Set conforms to the Minimum Standard (OMET 200). It shall produce an on-screen report and a hard copy report on this test if required by the Driver, Guard or other authorised person. The train certification test shall indicate three levels of result:

- a) Pass – the system concerned conforms to the Minimum Standards in full;
- b) Fail – the system concerned does not conform to the Minimum Standards; or
- c) OMET – the system concerned conforms to the Minimum Standards for a Set entering service from an Out Depot but does not conform to the Minimum Standards for a Set entering service from a Maintenance Centre or the Maintenance Facility.

RFTA  
00208

The TOS shall be connected to TOS screens mounted in the Driver's Workstation and Guard's Workstations for information display, alarm monitoring and data entry. Two equal and redundant TOS screens in each Driver's ~~Cab~~ Workstation and one TOS screen in the Guard's ~~Cab~~ Workstation shall provide the Driver and Guard with information regarding the operating status of the Set, system health and Failure management actions performed by the TOS. The TOS screens shall be configured to be viewed when seated or standing. ~~In the end Cab~~ The required redundancy for the Guard may be provided by enabling the Guard to use the TOS screens in the Driver's Workstation as a back-up to a single TOS screen mounted on the Guard's own Workstation.

The TOS screen shall provide the facility for the Driver and Guard to input railway operations information and shall be structured as set out within Appendix L – TOS Hierarchy.

The TOS screen shall use backlit colour flat screen technology and be software driven by the TOS. The screen brightness shall be adjustable by the Driver or Guard and the settings shall be suitable for day and night time use. Commands shall be entered by the Crew using a touch screen. To maximise Crew familiarity the TOS screen shall be configured in line with similar equipment as provided in Appendix M – TOS Interface.

RFTA  
00209

Alternative layout and functionality to that specified in Appendices L and M may be proposed by PPP Co provided that such a proposal is supported by human factors studies involving RailCorp Crew and the proposal is Not Rejected by RailCorp.

RFTA  
00207

Once data has been acquired, a A single point Failure of any individual part of the TOS shall not result in a loss of data. The performance impact of any single point Failure of the TOS shall be minimised.

A download facility shall be provided to download data and information from the TOS. PPP Co shall provide any software required to enable the data exchange between the TOS and a laptop computer.

The TOS screen shall show fault information on an overview diagram that represents the whole Set and shall show information on an individual Car basis.

The TOS programming shall allow for easy data entry and function changing and upgrading throughout the life of the system.

#### 7.4.1 TOS Screen use by Maintenance Staff

It shall be possible for a TOS screen in a non-active Driver or Guard's position to be switched into maintenance mode during operation of the Set. When maintenance mode is selected on an active Set, indication shall be provided to the Crew that this is the case.

### 7.5 Maintenance

The TOS shall interface to all Set systems and Subsystems as specified in Appendix K – Train Operating System and shall monitor additional information indicating when maintenance is required and display it to authorised personnel.

The TOS shall have a maintenance mode capability and can be switched to this mode at any time. It shall be possible for the TOS in any non-Active cab to be switched to maintenance mode at any time to monitor train equipment status in real time.

Operation of a remote TOS in maintenance mode must not affect any of the Guard or Driver control functions.

**7.6 Event Recorder**

Each Set shall be provided with two Event Recorders. The Event Recorders shall accurately record selected operational data of the Set pertinent to investigation of abnormal events. It shall allow data to be retrieved when required for analysis and provide support facilities to enable easy analysis of data.

The performance requirements, software requirements and list of items monitored by the Event Recorder shall be in accordance with Appendix N – Event Recorder. The list in Appendix N – Event Recorder constitutes a minimum requirement and this shall be developed by PPP Co during the Contract to take account of all of RailCorp’s requirements.

Easy access to all Event Recorder units shall be provided for downloading of data.

The date and time of day recorded shall be from the same source as the time shown on the TOS displays.

The location of the Set on the Rail Network shall be recorded using GPS coordinates.

All monitoring inputs shall incorporate some form of electrical isolation such that no Failure of the Event Recorder will corrupt the monitored signals or cause incorrect operation of any Set-borne equipment. The information recorded on the status of one piece of equipment shall not be affected by changes in other incoming signals.

Any abnormal operation of the Event Recorder shall be shown on the TOS alarm display and the status of the Event Recorders in the Set shall be displayed to the Driver without the requirement for Driver navigation of any TOS screens.

**7.7 ~~Guard’s Cab Not Used~~**

**7.7.1 ~~General facilities Not Used~~**

~~Unless stated otherwise the Guard’s Cab shall have similar facilities (including doors, lighting, HVAC provisions and two seats) as the Crew Cab at the outer end of the Set.~~

**7.7.2 ~~Guard’s Cab Size and Location Not Used~~**

~~The Set shall accommodate a Guard’s Cab in the end of one of the two Cars in the centre of the Set.~~

~~The Guard’s Cab shall have an available floor space similar to the Driver’s Cab.~~

**7.7.3 ~~Guard’s Cab Doors and Windows Not Used~~**

~~The bodyside doors from the Guard’s Cab shall have similar features and facilities to the Driver’s Cab bodyside door.~~

~~The door separating the Cab from the Saloon shall be similar to the Driver’s Cab transverse door. The doors separating the Passenger areas from the Guard’s Cab shall be provided with a shutter or similar, controlled from the Guard’s Cab. Such a shutter shall effectively obscure vision into the Guard’s Cab from the End Saloon and prevent light from the End Saloon entering the Guard’s Cab. In the open position, the window shall be exposed to ensure visibility of the Passenger areas from the Cab.~~

~~The arrangement of the Guard’s Cab at the intercar end shall provide an access path at least 850mm wide for wheelchair bound Passengers. The Cab shall be separated from the intercar gangway connection but shall have easy access to and a clear view of the adjacent Car. The sizes of doors and windows shall be similar to the door on the Saloon end of the Cab.~~

**7.8 Guard’s Station**

The Guard shall have the ability to operate all Guard’s equipment from any Driver’s ~~or Guard’s~~ Cab, including the Crew Cab in active use by the Driver. The Workstation shall include a flat area suitable for writing and accommodate the use of an opened A4 sized Timetable.

Letter RC00273

Letter RC00273

The Guard's Workstation shall integrate the TOS and all relevant controls to operate the Set's equipment as set out in Appendix I – Crew Controls standardising the layout as shown in Appendix H – Cab Layout and Appendix R – Control Switch Panels.

~~The Guard's controls and their layout in the leading end and central Cabs shall be consistent unless otherwise agreed with RailCorp.~~

7.8.1 Not used

7.8.2 Not used

7.8.3 Guards PA Control

A Public Address intercom shall be provided in the vicinity of each Crew bodyside door. The panels shall include a facility for the Crew to make Public Address announcements (both internal and external) and an intercom facility.

7.8.4 Guard's Door Indicator Light

When any or all Passenger bodyside doors are open and any door linked safety circuits are not correctly energised the Guard's door indicator light shall illuminate. When the doors are locked and all safety systems correctly energised, an audible alert consisting of three (3) beeps shall sound to alert the Guard. The sound of the alert shall be equivalent to the sound used in the Guard's Audible Indication Device (AID) on other CityRail trains.

7.8.5 Guard's Door Control Panel

RFTA  
00086  
RFTA  
00198

Passenger bodyside doors shall be controllable (open and close) from each of the Guard's Door Control panels located on the Cab back wall adjacent to the each Crew bodyside door. ~~The~~ With the exception of the EDR Crew Override and Crew Override Cancel controls, the controls located on a particular side of the Set shall control the doors on that side of the Set only. The controls shall be positioned relative to and integrate with the CCTV screens and the Crew bodyside access door handrails to ensure safe and ergonomic operation by the Crew.

The panel/s shall provide the following functions:

- a) bell signal by push button;
- b) door open by push button;
- c) door close by push button;
- d) door open indication;
- e) door fault indication;
- f) ~~local Crew door open and close not used;~~
- g) Door Warning Device (DWD) push button;
- h) ~~Car selection control for door open command overshoot pushbuttons.~~
- i) Passenger bodyside EDR Stage 1 Activation indicator light
- j) Passenger bodyside EDR Crew Override by illuminated push button
- k) Passenger bodyside EDR Crew Override Cancel by push button
- l) Passenger bodyside EDR Stage 2 Activation indicator light

RFTA  
00086  
  
RFTA  
00198

<p>RFTA 00198</p>	<p><u>The Passenger bodyside EDR Stage 1 Activation indicator light and Passenger bodyside EDR Crew Override illuminated push button shall only be able to be illuminated in an active driver's cab in the event that::</u></p> <p><u>i) There is no active guard's workstation on the Set, or</u></p> <p><u>ii) Both the active guard's and driver's workstations are in the same cab.</u></p> <p>All controls on the panels shall be differentiated using visual and tactile means to minimise the risk of inadvertent operation. <del>A set of duplicate controls consisting of items a) to d) inclusive and g) (as indicated above) shall be fitted to an agreed location on each side of the Crew bodyside doors.</del></p>
<p>RFTA 00086</p>	<p><u>A set of Crew controls shall be fitted to the cab side pillar adjacent to each Crew bodyside door to operate that Crew bodyside door. The panel/s shall provide the following functions:</u></p> <p><u>a) emergency close by push button;</u></p> <p><u>b) reset/isolate by rotary switch;</u></p> <p><u>c) crew lights by push button;</u></p> <p><u>d) crew door open by push button;</u></p> <p><u>e) crew door close by push button.</u></p>
<p>Letter RC00273</p>	<p><b>7.8.6 Guard's Emergency Brake Cock</b></p> <p>Each Guard's position <del>in both, the Guard's Cab and the Driver's Cab,</del> shall be fitted with an independent Emergency Brake control that shall vent the Brake Pipe to atmosphere and enable an Emergency Brake application. The control shall be compatible with the Equipment Examiner's lock out device as detailed in Appendix X – Guard's Emergency Cock Lock-out.</p>
<p><b>7.9 Driver's Safety System</b></p>	<p><b>7.9 Driver's Safety System</b></p> <p>A Driver Safety System incorporating Driver detection devices and a Vigilance Control shall be fitted. All Driver Safety System devices shall be designed to prevent bypass of their intended function. Each safety system shall be configured separately with no common components or functionality, except that the Operator Enable Pedal shall additionally operate the Vigilance Control.</p> <p>The Set shall comply with RSU Appendix D amended as follows:</p> <p>D3.2 Delete existing text</p> <p>D5.2 and D5.3 Delete "with circumvention of deadman system by coasting barred by the train control system" and after full stop add "The train control system shall not allow the Set to start or continue in motion with the Driver Safety Systems isolated, except under Degraded operating conditions."</p> <p>D6.2.2 Delete "When the Brake Pipe...to a halt." Add "In addition to making an Emergency Brake application the Set shall isolate traction power."</p> <p>D10.3.6 Delete "Suitable positions...Section D11.5 Ergonomics."</p> <p><b>7.9.1 Driver Detection</b></p>
<p>RFTA 00282 RFTA 00338</p>	<p>A Driver detection system shall be provided. The system shall use two modes of operation, an Operator Enable Pedal (OEP) and a force exerted on the power/brake controller handle. The OEP shall meet the requirements of RS SP-05-01-05-01. <u>Clause 2.2.3, clause 5.1, <del>clause 6</del> and clause 8 of RS SP 05-01-05-01 shall not apply, and the OEP shall meet the following additional requirements:</u></p>
<p>v18 – 17/01/2011</p>	<p>Page 88 of 165</p>



The force required to depress the OEP from the release to the stage 1 (Normal Operating Range) position shall be 50N ± 10N and from the stage 1 to the stage 2 (Vigilance Acknowledge Range) position shall be 120N ± 20N. The force hysteresis at the enable switching position shall be less than 10N and the hysteresis at the vigilance acknowledge switching position shall be between 5N and 25N. For measurement purposes the force shall be applied at a single point in the centre of the pedal, 240mm from the bottom edge and shall be normal to the pedal.

The maintenance support, documentation and other relevant requirements described in the Contract Management Requirements and the RailCorp Through Life Support Specification shall apply. The Driver detection system design and operation shall be such that it minimises the risk that it can be over-riden or tampered with in order to negate the safety feature. The system shall be active in all driving modes.

RFTA  
00231

7.9.2 Safety System ~~Suppression~~ Emergency Button

In the event of a Failure of a Driver Safety System or a subsidiary device that prevents movement of the Set, the design shall allow for a second Crew member to over-ride the system by depressing the "emergency button".

This emergency button shall be located such that the Driver cannot operate it whilst driving the Set.

This emergency button shall be located such that the second Crew member can view the Brake Pipe gauge, the Driver, and the track and signals ahead while operating the emergency button.

This emergency button shall be located such that the second Crew member does not need to stand to operate it. The button shall be aligned such that it cannot be operated by having an object put on top of it.

The emergency button shall be non-latching i.e. the second Crew member shall be required to continually depress it in order to over-ride the system.

RFTA  
00247

This emergency button shall only allow traction to be available if one of the Driver detection devices is also enabled (i.e. the Driver either operates the combined controller detection device or the OEP) not allow the system to be over-riden unless the driver detection system is active.

7.9.3 Not used

7.9.4 OEP Operation

RFTA  
00139

Providing the OEP is maintained in the normal operating range it shall be possible to suppress the application of the Emergency Brake and to enable traction. The normal operating range shall provide tactile feed back to the Driver in accordance with RailCorp specification RS SP 05-01-05-01-1 2005 with the exception of the height adjustment range in clause 2.1.7 of RS SP 05-01-05-01-1 2005 where a smaller adjustment range is shown by human factors analysis to meet Drivers' requirements.

If the OEP is fully released and the combined controller driver detection device is not set, then the Emergency Brake shall be applied and traction disabled. Fully depressing the OEP shall cause the Driver Safety System to operate as specified in FE 152.

Resetting of either the OEP or combined controller driver detection device shall immediately cause the traction and braking system to revert to the condition pertaining immediately before operation of the OEP in a controlled manner meeting all ride, acceleration and Jerk requirements.

7.9.5 Vigilance Control

A Vigilance Control shall be provided which shall function in conjunction with the Driver Detection System controls.

The Vigilance Control shall cause a penalty Emergency Brake application and remove tractive effort if the Driver fails to respond to the system within the required time.

RFTA  
00076  
  
RFTA  
00281

The Vigilance Control shall comply with RailCorp's Specification FE 152 with the exception of Clauses 4.4, 5.1.2 and 5.1.3 or where amended by the requirements contained below.

The Vigilance Control shall provide the following:

- a) A Pre-Warning stage of 30 seconds, 1<sup>st</sup> Stage warning of 5 seconds and a 2<sup>nd</sup> Stage warning of 5 seconds. No speed linking shall apply.
- b) The Vigilance acknowledgement button shall be fitted with a blue light suitable for night operation and which shall not form a distraction to the driver.
- c) A no-reset period, after a Penalty Brake Application, of 3 seconds.
- d) Warning Advance for the Vigilance acknowledgement button of 1.5 seconds which advances to 1<sup>st</sup> Stage warning only. (Note OEP to remain at 3 seconds and advance directly to 2<sup>nd</sup> Stage warning).
- e) In the 2<sup>nd</sup> Stage warning, the Vigilance visual warning lights and audible warning shall be coordinated such that the lights are on when the audible warning is sounding and off when the audible warning is silent.

RFTA  
00319

When the Vigilance Control is isolated, the Set may only be powered and driven by operation of the emergency button.

The Vigilance Control bell sound and that of the Crew bell signal shall be clearly differentiable.

#### 7.9.6 Trip Gear Control

Facilities to manually raise, lower and isolate the Trip Gear shall be provided at or near the trip valve. A manual reset facility located on the Trip Gear shall be provided.

Facility to remotely reset the Trip Gear from the Driver's Workstation when the Set is stationary shall be provided. The status of the Trip Gear (raised/lowered/isolated) shall be displayed to the Driver in the TOS main status screen.

### 7.10 Isolation of Equipment and Emergency Equipment

A method for the manual isolation by Crew or support personnel of any equipment or Subsystem shall be provided.

#### 7.10.1 Brake Cylinder Isolation

It shall be possible for the Driver to isolate the bogie brake cylinders on each bogie at the underframe.

#### 7.10.2 Park Brake Isolating Cock

A Park Brake isolation cock shall be provided for each bogie fitted with a Park Brake. The cock shall be accessible by the Crew without lifting any underframe skirt.

#### 7.10.3 Access Hindrance by Passengers

Any equipment that may require resetting, checking, or adjusting by the Crew shall not be located where access to such equipment is hindered by seated Passengers.

#### 7.10.4 Isolating Cock Location

As far as is reasonably practical, isolating cocks shall be standardised into locations as per Appendix Q – Isolating Cock Positions.

Isolating cocks which may need to be accessed by Crew or Maintenance Staff shall be accessible to authorised staff standing at track level.

It shall also be possible for staff at platform level to operate isolating cocks whilst the Set is adjacent to a platform.

7.10.5 Isolating Cocks Between Cars

Isolating cocks shall be provided at each end of the Car to isolate all air connections between adjacent Cars. These cocks shall be mounted on the underframe, and be accessible to staff from the track level. Mounting of the end cocks shall ensure sufficient strength to overcome stiffness due to infrequent use, and ensuing rough handling to operate.

Main reservoir end cocks shall have their handles pointing towards the end of the car when in the open (in-line) position. Brake Pipe end cocks shall have their handles pointing towards the centre of the car when in the open (in-line) position. Both main reservoir and Brake Pipe end cock handles shall point vertically upwards when in the closed position, unless they are located under the Side Sill in which case the handles shall point vertically downwards when in the closed position.

7.10.6 Cock Handle Orientation and Access

All isolating cocks unless otherwise specified, shall be designed such that their handles are at right angles to the line of the pipe when isolated and parallel to the line of the pipe when open. All valves in one location shall have the same directional orientation. All equipment isolating cocks shall vent the equipment being isolated unless otherwise specified. The Brake Pipe end cock shall be of the full port venting type that has a rate of venting not less than the rate of delivery of air.

Location and size of the handle shall be such as to maximise the ease of operation and minimise the risk of injury to staff when using the controls.

7.10.7 Cocks - Labelling

RFTA  
00057

All isolating cocks shall be clearly labelled and have their handles painted white. Such labelling shall be legible under all conditions when adequately illuminated, (maximum 4 letters, each 25-50 mm high). Isolating cock labelling shall conform ~~RailCorp standards~~ to Appendix Q. Additional labelling for isolation cocks shall be submitted in accordance with CMR Attachment 4 item 6.2.21.

7.10.8 Spring Load Cock Handle

RFTA  
00323

All isolating cocks (except where otherwise stated or as agreed with RailCorp) shall have spring-loaded latching handles to prevent their accidental movement. Latches shall hold the cock in isolated and non-isolated position, and require disengagement to allow movement. Latching shall be automatic in either position.

7.10.9 Safety Apparatus Isolation

The Safety Apparatus includes Trip Gear, driver detection devices and the Vigilance Control. RailCorp will consider designs with independent or group isolation of the safety apparatus. Safety Apparatus isolating cocks shall have the handle at right angles to the pipe when the Safety Apparatus is operable. The Trip Gear isolating cock shall be located under the Crew Cab, above the No. 8 wheel and adjacent to the Trip Gear, which it operates.

7.10.10 Safety equipment locker and emergency equipment box

Safety equipment and emergency equipment shall be provided in each Crew Cab. The emergency equipment shall be stored in an emergency equipment box. The safety equipment and the emergency equipment box shall be stored in a safety equipment locker.

The safety equipment locker shall be fitted with a Brooks "Pullrite" yellow plastic seal punched with a date 4 months earlier than the expiry date of the oldest detonator contained within.

The emergency equipment box shall be fitted with a lock to RailCorp drawing 401-510 part M5-598 and a Brooks "Pullrite" yellow plastic seal punched with the expiry date of the oldest detonator contained within.

The maximum time to access the spare trip gear hose and fit it to the Set shall not exceed 5 minutes, based on access by trained staff.

The required contents of the safety equipment locker and the emergency equipment box are specified in Appendix U.

7.10.11 Emergency Equipment Size and Mass

The size and mass of the emergency equipment stored inside the Car shall be such that it is able to be readily accessed and removed by one person whilst complying with NOHSC:1001 and NOHSC:2005.

**7.11 Guard's Cab – Pre-Agreed Variation Not Used**

In the event that RailCorp exercises its right under clause 30.17 of the Conditions of Contract (Pre-Agreed Variation) the following clauses of this RailCorp Train Performance Specification will be amended as follows:

*2.2 Set Configuration*

Delete second paragraph.

*3.5.6 On-Board Systems (b) Requirements (ii) "head" unit*

In first sentence, delete "and each Guard's Cab".

*6.2.8 Passenger Seats (p) wheelchair spaces*

Amend last sentence to read "No Wheelchair Spaces shall be located in the End Saloons adjacent to Crew Cabs."

*6.7.2.3 Passenger Door Emergency Operation*

Delete item (d). Item (e) becomes item (d). In final paragraph delete third sentence (commencing "Connection of the Guard's Cab EDR...").

*6.7.3 Intercar Access Doors*

Amend first paragraph to read "Lockable bi-parting intercar doors shall be provided at each end of each Car, not including the terminal ends of each Set. At these locations a Crew transverse door shall be provided."

*7 Train Crew Requirements*

Amend last paragraph to read "Within this specification requirements for Crew Cabs shall also apply to Driver's Cabs".

*7.1.6 Storage Areas*

Amend "three wheelchair ramps" to "two wheelchair ramps" in third paragraph.

*7.3.5.2 Emergency Brake Pipe Cock and Gauge*

Delete last sentence.

*7.7 Guard's Cab*

Amend heading to read "not used". Delete all text from clauses 7.7.1, 7.7.2 and 7.7.3.

*7.8 Guard's Station*

In first paragraph delete "or Guard's Cab". Delete third paragraph.

*7.8.6 Guard's Emergency Brake Cock*

Amend first sentence to read "Each Guard's position shall be fitted with an independent Emergency Brake control that shall vent the Brake Pipe to atmosphere and enable an Emergency Brake application."

*12.1 Interior Design Workshops*

In second paragraph, first sentence delete "and Guard's Cab".

*12.2.3 Guard's Cab*

Delete clause.

*Appendix H Cab Layout*

Letter  
RC00273

Letter  
RC00273

---

Amend title of Figure 1 to read “Cab Layout – Driver’s Workstation”. Amend title of Figure 2 to read “Cab Layout – Guard’s Workstation”.

*Appendix K Train Operating System 3.1 Display Units*

Amend first paragraph, third sentence to read “Two TOS screens shall be provided at each Driver’s Workstation and one TOS screen at each Guard’s Workstation.”

*Appendix U Train Emergency Equipment*

Delete column headed “Guard’s Cab (quantity)” from table of contents of the safety equipment locker.

Note also that various clauses in the Dictionary of Technical Definitions and Abbreviations, the Contract Management Requirements, the RailCorp Through Life Support Specification and the RailCorp Simulator Specification will also be amended in the event that the Pre-Agreed Variation to delete is exercised. Please refer to each of those documents.



**8 Power and Electromagnetic Compatibility**

**8.1 Electromagnetic Compatibility**

RFTA  
00042

Set electromagnetic emissions, radiation and immunity shall be in accordance with the requirements of SC0018 00 00 SP, and EN 50121 and shall also meet the levels specified in ENV 50166 however there shall be no requirement for a NATA certified test to be performed against ENV 50166 provided that the ENV 50166 levels shall be produced by a test agency NATA certified to EN 50121 or equivalent standard. The electromagnetic emissions shall not interfere with implanted medical devices.

**8.2 Main Power Supply (MPS)**

8.2.1 Specifications & Standards

The Main Power Supply shall conform to FE 117 Electrical Circuits and Equipment for Rolling Stock, and FE 116 General Principles, Construction, Mounting and Installation of Electric Equipment for Rolling Stock.

8.2.2 Pantograph

Electrical supply for the Set is provided via a nominal 1500 V dc Overhead Wire (OHW). The Set shall use a pantograph system to connect to the OHW for all of its required power during normal operation.

Each Set shall have at least two pantographs and no more than four, connecting the Set to the OHW, and conveying electrical power to the Set Subsystem via High Speed Circuit Breakers.

RFTA  
00082

The pantographs shall be compliant with the requirements set out in ~~IEC Publication 494 – Rules for Pantographs of Electric Rolling Stock~~ IEC 60494-1:2002 – Railway applications – Rolling stock – Pantographs – Characteristics and tests – Part 1: Pantographs for mainline vehicles, RSU Appendix E and FE 119 with the exceptions that:

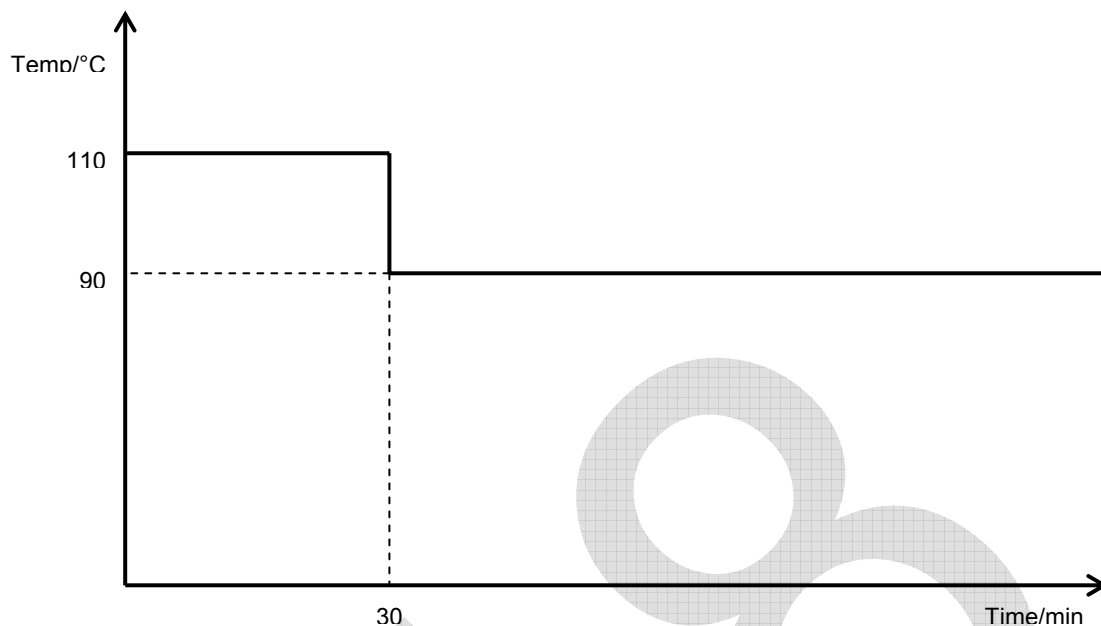
- a) The requirement in RSU Appendix E clause E5.2 shall not apply;
- b) The sentence in FE 119 clause 3.2.6 “The method...used by State Rail Authority in 1997.” shall not apply;

RFTA  
00092

- c) The time for the pantograph heads to fall ~~to rest below car roof height~~ shall not exceed 3s seconds; and
- d) The requirement in FE 119 clause 3.2.8 shall be met by the reliability analysis requirements set out elsewhere in the Contract Management Requirements documentation; and

e) The requirement in FE119 clause 4 Qualification, paragraph 3 shall be replaced by: “The temperature of a sample of 193 mm<sup>2</sup> hard drawn new copper contact wire under a tension of 16.5 kN and subjected to a pantograph force of 110 N, when subjected to the maximum current drawn by a stationary Set through a single pantograph under all conditions, measured at its hottest part shall not exceed 110°C for 30 minutes and shall not exceed 90°C thereafter, as indicated in the following diagram:

RFTA  
00096



**8.2.2.1 Pantograph Cock**

If the pantograph is pneumatically raised or lowered, the air supply to the pantograph raising equipment shall have a vented pantograph isolating cock with the following functional positions:

- a) Pantograph lowered and vented - Handle across line and be vertically oriented above the valve body. The vent size shall be suitable to ensure that the pantograph will not raise if the cock leaks through when isolated or such that the vent could become blocked due to contaminants; and
- b) Pantograph raised - Handle in line.

If the pantograph is raised or lowered by other means then similar controls shall be provided.

**8.2.2.2 Pantograph Lowering and Load**

The Driver's Workstation operated control system for pantograph control shall open the High Speed Circuit Breaker prior to lowering the pantograph from the Overhead Wire.

**8.2.2.3 Pantograph Manual Operation and Isolation**

Each Car equipped with a pantograph shall have a manually operated pantograph control system, located in a locked cupboard, to raise, lower and isolate the pantograph from the Overhead Wire.

The Isolation equipment shall be consistent in layout to existing rolling stock irrespective of type of pantograph control system.

The local manually operated pantograph control system shall not prevent remote lowering of the pantograph from the active Driver's Workstation, nor shall it affect any other pantograph on the Set.

**8.2.2.4 Pantograph Protection**

With the pantograph raised, damage shall not occur in the event of a Set travelling into a non OHW region. An over reach protection mechanism shall be provided to lower the pantograph and shall take into account the contact wire height throughout the Rail Network.

The pantograph shall be fitted with an automatic drop device to protect the OHW from damage in the event that the pantograph mating surface becomes badly damaged or excessively worn.

8.2.2.5 *Auxiliary Raising*

RFTA  
00069

An auxiliary method of raising pantographs shall be provided in the event that the primary power supply is unavailable. When using this method, the time to raise all of the pantographs equipped with an auxiliary compressor shall be less than 20 seconds.

8.2.2.6 *Multiple Overheads*

The pantograph design shall allow for smooth transition of the contact wire with the contact surface of the pantograph for all operational situations and maximum allowable service speeds, including converging and diverging contact wire or where the wire contains mechanical discontinuities as detailed in RSU Appendix E.

8.2.2.7 *Car Movement*

The pantograph contact pressure shall be maintained for all Car to Overhead Wire relative displacements.

8.2.2.8 *Clearance*

RFTA  
00098

High Voltage clearance shall comply with ~~IEC77~~ except electrical creepage and clearances, which shall comply with BS2618, except where otherwise stipulated in this RailCorp Train Performance Specification, throughout all movements of the pantograph.

RFTA  
00236

8.2.3 *Carriage Insulation*

The insulation resistance of the power supply cabling and systems from the Car body shall comply with, be tested and the results reported in accordance with the requirements of ~~BS2618~~ IEC60077.

8.2.4 *Momentary Loss of Supply*

The Main Power Supply shall not electrically isolate as a result of disruption in power from the overhead for at least 2 second, such as may occur when passing section insulators, air gaps or during "pantograph bounce".

**8.3 High Speed Circuit Breaker**

RFTA  
00097

At least one High Speed Circuit Breaker (HSCB) per pantograph shall be provided to clear high voltage faults. Provided the OHW voltage limits are met, the HSCB shall close when the pantograph is raised. HSCB shall open before the pantograph is lowered or when a fault occurs, which would cause excessive line currents to be drawn.

8.3.1 *Energy Storage*

Under any circumstances when the HSCB opens, the energy on the normal load side of the HSCB(s) shall be dissipated to earth. The residual voltage shall not exceed 60V after 1 minute. Indication shall be provided to Maintenance Staff of the residual voltage.

8.3.2 *Interconnection*

No equipment shall be connected in parallel with the HSCB, with the exception of detection and control equipment for the HSCB.

8.3.3 *Switching*

All high voltage switching via mechanical switch-gear shall take place under minimum load except under fault conditions.

8.3.4 *Faults*

Faults on the supply side (OHW) of the HSCB will generally be cleared by the substation.

The Set protection equipment shall be capable of clearing fault currents below the minimum substation trip point.



For faults on the load (Set) side of the HSCB, the Set protection equipment shall clear the fault without interruption to the line supply (i.e. adequate discrimination shall be provided between the substation and train Circuit Breakers).

High Speed Circuit Breakers shall blow out into a removable, fully enclosed arc box, and the surrounding area shall be vented.

#### 8.4 Protection

All Set-borne electrical equipment shall be protected from damage due to voltage transients, losses, steps and hysteresis reactivations which may exist on the RailCorp system due to the operation of the Sets or existing equipment.

#### 8.5 Earthing

The car-body and bogie shall be earthed in accordance with FE 117.

PPP Co shall provide an earthing arrangement for the potential event of a Set being derailed, including a suitable method to prevent an electrical high tension path being created to the derailed bogie(s) that may not have a parallel connection to the rail via another bogie.

The Set design shall also consider the risks associated with live electrical conductors making contact with the Set roof and provide adequate protection and earth paths to mitigate such risks.

#### 8.6 Earth Connection

Axle return current brushes shall electrically connect the Car body and wheels ~~such that there is no potential difference being maintained between them and that there is no current path so as to minimise the chances of current passing through axle journals, traction motor bearings and gearbox bearings that would cause damage to those bearings.~~

RFTA  
00259

#### 8.7 Earthing arrangements for maintenance staff safety

##### 8.7.1 1500 V dc earthing system

The Sets shall be fitted with a Safety system which will enable maintenance personnel, intending to work on the 1500 V dc system or equipment on a Set, to lower and isolate all pantographs on the Set, to apply a secure earthing connection to the 1500 V dc wiring, and to lock the isolation and earthing arrangement to render the 1500 V dc system or equipment safe against any application of power by any means whilst work is progressing.

##### 8.7.2 415 V ac earthing system

The Sets shall be fitted with a Safety system which will enable maintenance personnel, intending to work on the 415 V ac system or equipment on a Set, to lower and isolate all pantographs on the Set, to apply a secure earthing connection to the 415 V ac wiring (including shore supply), and to lock the isolation and earthing arrangement to render the 415 V ac system or equipment safe against any application of power by any means whilst work is progressing. This Safety system may be part of, or included in, the Safety system described in clause 8.7.1 above.

**9 Auxiliary System**

**9.1 Electrical Auxiliary Power Supply**

The Electrical Auxiliary Power Supply (EAPS) shall be supplied with power from the Main Power Supply. The EAPS shall be disconnected from the Main Power Supply in Fault or Failure conditions.

RFTA  
00315

The EAPS shall be designed such that each individual Electrical Auxiliary Power Supply module may be isolated from the Main Power Supply via the TOS screen only when the TOS screen is in maintenance mode.

RFTA  
00091

~~The EAPS shall have a staggered starting regime to prevent unnecessary inrush current during initial start-up.~~  
With all four pantographs in the raised position, the EAPS shall limit the maximum in-rush current of the Set during initial start up to no greater than 200A and shall comply with the requirements of RSU Appendix E 6.2 in all other respects.

9.1.1 EAPS Equipment De-rating

RFTA  
00080  
00081

The capacity of the EAPS shall ensure that no de-rating is required for any equipment installed or plugged into the General Purpose Outlets or Special Purpose Outlets.

The EAPS shall comply with IEC 61287 TS and IEC 446 60146

9.1.2 Isolation from Auxiliary Power

The insulated high tension negative of the EAPS 1.5 kV dc input side shall be kept separate from the insulated negative and neutral circuits of the EAPS auxiliary output voltage, except where these effectively are connected via the axle earth return brush connections of the Set.

9.1.3 EAPS Voltages

The voltage ranges applicable to RailCorp's existing rolling stock for the EAPS are defined in RailCorp's Specification FE 117. The EAPS shall provide the following supplies at similar voltage levels to those stated:

RFTA  
00079

- a) Control & lighting supply of 110 V dc ~~to 120 V dc~~;
- b) Control & lighting battery charging;
- c) 400 V to 415 V ac 3-phase; and
- d) 230 V to 240 V ac single phase.

9.1.4 EAPS Functional States

*9.1.4.1 Shore Derived Supply*

The shore supply shall be interlocked with the Main Power Supply interface to prevent having both systems connected to the Set simultaneously.

The shore supply at existing RailCorp maintenance centres is at 400 V to 415 V ac 3-phase 50Hz using a connector as shown in RailCorp drawing no. C83656.

Shore supply jumpers shall be interlocked so that power is not present prior to connection being made or broken. Any shore supply socket on a Set that does not have a shore supply connected to it shall not have any power present. Refer to FE 116.

*9.1.4.2 Main Power System Derived Supply*

The Main Power System derived supply shall consist of two modes:

- a) EAPS normal operation - the EAPS shall supply power to all Systems and Subsystems as required and itemised in this specification; and

- b) EAPS emergency redundancy - in the event of partial auxiliary supply failure, the Set shall shed only HVAC heating or cooling load. The percentage shed shall not exceed the percentage of the auxiliary supply capacity lost.

9.1.4.3 EAPS Stabled Mode

When in Stabled mode, all EAPS outputs other than the provision of power to the marker lights, TOS, Event Recorder, communication equipment, Crew Cab and step lights and the provision of power to enable unstabling shall be isolated. Power to the TOS, Event Recorder and data communications will self isolate once any necessary data transfer is complete and the TOS correctly closed down.

9.1.4.4 EAPS Isolated Mode

The EAPS supplies shall be able to be individually isolated.

9.1.5 EAPS Power Interruption Immunity

The EAPS shall suffer no adverse effect from any power interruptions or fluctuations.

9.1.6 EAPS Transient Production

The EAPS shall not produce any transients under power interruption conditions, which could damage or cause mal-operation of any equipment.

9.1.7 EAPS Loss of Supply

The Set shall continue to perform normally under brief interruptions of power. ~~The effect of interruptions on Saloon and other lighting shall be minimised. Main Lighting circuits shall be maintained for 15 seconds after a loss of power.~~

RFTA  
00035

9.1.8 Reset Functions

All operational units shall automatically reset upon restoration of an interrupted Electrical Auxiliary Power Supply.

**9.2 EAPS Batteries**

Separate batteries shall be provided for the control and lighting circuits.

9.2.1 Lighting Battery

The lighting battery and battery charging system shall supply all dc lighting and emergency ventilation loads. Depletion of the lighting battery shall be limited by a low voltage cut-out set at the battery manufacturer's recommendation. The lighting battery low voltage cut-out shall switch off all dc lighting loads.

9.2.2 Control Battery

The control batteries and battery charging systems shall supply all battery loads not supplied by the lighting batteries.

9.2.2.1 EAPS Stabling and Stabled

During stabling the EAPS shall continue to supply power to the TOS and necessary circuits until stabling is completed and the set in Stabled mode.

When 80% charged the control battery shall still have sufficient energy to raise the pantograph, after having supplied the maximum control load for 4 hours.

The battery and charging system shall enable the batteries to recover from 20% charged capacity to 80% charged capacity within 3 hours under full battery charging capacity.

9.2.2.2 *Control Battery Capacity*

From full charge the control batteries shall have the capacity to supply the maximum control load for not less than 4 hours, without being charged, prior to the operation of the battery cut out.

9.2.2.3 *Control Battery Discharge Limit*

Discharging of the control battery shall be limited by a low voltage cut-out set at a level not to cause battery damage.

9.2.2.4 *Control Battery Restart*

After operation of the control battery cut-out, the control battery shall have sufficient stored energy for the Set to be restarted after four weeks duration.

9.2.3 *Battery Isolation*

The EAPS shall be designed such that both poles of each battery circuit may be physically isolated from within the Car. Isolation shall be accomplished without the use of tools.

9.2.4 *Emergency Loads*

The Electrical Auxiliary Power Supply system shall provide power to emergency loads when no overhead 1500 V dc power supply is available. The supply to Set lighting systems shall be provided on a Car by Car basis and shall be maintained in the event of Set separation or Car rollover. The batteries shall be maintained at an adequate level of charge to satisfy the requirements set out in Table 10 below:

System maintained	Time
Communication systems (including CTIP) except for Train Radio equipment, PA and Intercom	90 mins after loss of OHW power
Emergency ventilation	90 mins after loss of OHW power
Emergency <u>Operation</u> lighting Stage 1 <u>Lighting</u>	90 mins after loss of OHW power
Door release of alternate doors on either side	4 hours after loss of OHW power
Emergency <u>Operation</u> lighting Stage 2 <u>Lighting</u>	4 hours after loss of OHW power
Train Radio equipment, PA and Intercom	4 hours after loss of OHW power
Train controls (at full load)	4 hours after loss of OHW power
Fire detection system	4 hours after loss of OHW power

RFTA  
00280

RFTA  
00280

**Table 10: Emergency Battery System**

9.2.5 *Battery Emergency Switch*

An emergency switch shall be provided to allow the lighting battery to supply the control circuits for starting, if the control battery is unable to provide sufficient power.

It shall not be possible to connect the control and lighting batteries in parallel.

9.2.6 *Battery Fuses*

Each battery shall be protected by two fuses, one connected in each of the positive and negative circuits.

### 9.3 Battery Charging

RFTA  
00090

There shall be at least two battery charging systems per Set, configured as a dual-redundant pair. Each charging system shall be capable of charging all batteries in the ~~Set dual-redundant pair~~. Changeover on Failure from one charging system to the other shall be fully automatic. There shall be no single points of Failure between the battery charging system and the batteries, with the exception of switching to prevent paralleling of batteries.

When power from the Main Power System is available, the EAPS shall maintain the batteries in a charged state.

All batteries shall continue to be charged when one EAPS is isolated.

#### 9.3.1 Battery Charging System IP Rating

RFTA  
00253

Underframe and roof mounted battery charging system shall be protected to IP 55 defined according to ~~AS1939~~ AS 60529.

#### 9.3.2 Battery Regulation

The EAPS shall regulate the charging of the batteries to prevent battery damage.

### 9.4 EAPS Protection

All EAPS extra low and low voltage circuits shall be protected by individual Miniature Circuit Breakers, except those circuits that are required to have fuse protection.

There shall be galvanic isolation between all EAPS outputs and the 1500 V Main Power Supply except with respect to earth back to axle earth return connections.

#### 9.4.1 EAPS Protection

The EAPS shall ensure no degradation occurs to the Set's external interfaces, including the Overhead Wire and signals in the event of a fault or abnormal condition of the Set. The equipment shall provide protection to cover a full range of likely Failures and abnormal conditions.

#### 9.4.2 EAPS Fault Indication Initiation

A loss of EAPS output that is not a result of variation of Main Power Supply (e.g. Line under or over voltage) shall generate a fault indication.

#### 9.4.3 Circuit Breaker Selection

The characteristics of all Circuit Breakers shall be selected to protect all associated equipment and cabling from abnormal currents.

The EAPS 3 phase output shall be protected by overcurrent detection and contactors.

#### 9.4.4 Alternating Current Safety Control Function

An alternating current safety control function shall be provided to prevent alternating current auxiliary power circuit energisation unless both the alternating current supply is available and all the alternating current intercar connections are made.

#### 9.4.5 EAPS Spare Fuse

All fuse installations (excluding the main EAPS fuse) shall be provided with a spare fuse of each type. Spare fuses shall be within 1 m of the installed fuse and shall be on an identical fuse holder.

Battery fuses shall be provided with a fuse tester located within 1 m of the installed fuse, suitable for testing the installed fuse.

9.4.6 EAPS Induction Motor Protection

The EAPS shall automatically protect itself from Failure in the event of a load side induction motor Failure.

**9.5 Auxiliary Circuits**

PPP Co shall configure the EAPS into three separate supply circuits to include:

- a) dc control circuit;
- b) dc lighting circuit; and
- c) 3 phase ac circuit.

9.5.1 EAPS Operation Variation Limits

All extra low and low voltage circuits and equipment shall operate within the variation limits of BS2618.

9.5.2 Control and Lighting Power Circuits

Two separate direct current power circuits shall be provided one for control (including starting) and the other for lighting and emergency ventilation.

9.5.3 Power Flow

Subject to clause 9.2.5 (Battery Emergency Switch) of this RailCorp Train Performance Specification, it shall not be possible for power to flow from the control circuit to the lighting circuit or vice versa under normal operation.

It shall not be possible to connect the control and lighting power circuits in parallel.

9.5.4 Three Phase Output

The frequency of 50 Hz supplies shall be maintained within  $\pm 0.5$  Hz of the nominal value under all operating conditions.

The neutral of the 415 Volts RMS alternating current 50 Hz supply shall be earthed and load balanced to minimise neutral return current.

The total harmonic distortion of the 415 Volts RMS 50 Hz supply shall be less than 10%.

**9.6 Remote Supply**

9.6.1 Remote Supply

In the event of discharged control batteries on a Set, a remote supply connection point and jumper shall be provided to allow coupling of the control battery supply to another Set, for the purpose of starting the electrical and mechanical auxiliary power supplies. The remote supply jumper shall be stored in the safety equipment locker.

The paralleling of Set battery supplies between two or more coupled sets shall be prevented.

9.6.2 Remote Circuit Isolation

The remote supply circuit Miniature Circuit Breaker shall isolate the remote supply from all other circuits.

**9.7 Air Compressor Subsystem**

The air compressor Subsystem shall have sufficient capacity to supply the requirements to move another coupled 8-Car AW3 loaded CityRail train that has its pantographs lowered. It can be assumed that the train being moved will not have excessive air usage or leakage due to malfunctioning equipment.

9.7.1 Compressor Management

All compressors shall be controlled to maximise compressor life and optimise the efficiency of the air dryer system

RFTA  
00055

---

The compressor management system shall control the compressor and drier operation in order to achieve the reliability and availability targets for the Sets.

#### 9.7.2 Compressor Motor Switching

A switch or Circuit Breaker shall be provided to isolate each compressor. In the event of a Failure of the compressor control system, it shall be possible for the compressor(s) to maintain the correct air pressure.

#### 9.7.3 Operating Pressure Range

The air compressor Subsystem shall supply air to the main reservoir at a pressure and volume to ensure that the main reservoir does not fall below Brake Pipe pressure, Park Brake release pressure, control reservoir pressure and crush load air suspension (if fitted) pressure under peak demand conditions with 50% of compressors cut out.

#### 9.7.4 Safety Valves

The flow capacity of each safety valve shall be at least 110% of the total of the flow rate of all compressors on a Set.

#### 9.7.5 Check Valves

A check valve shall be fitted on the supply feed to each main reservoir.

#### 9.7.6 Air Leakage

With all compressors shut down and with all pneumatic equipment fitted and cut in, the air leakage shall not exceed, 15 kPa of main reservoir pressure per 5 minutes, for all pressures up to maximum operating pressure.

#### 9.7.7 Rate of Air Pressure Build Up

From the Stabled condition with no main reservoir pressure, the air system shall be at operational pressure within 9 minutes. This includes the air suspension which shall be fully charged (if fitted).

#### 9.7.8 Main Reservoir and Control Air Isolation

It shall be possible to isolate the main air supply and control air systems independently to cater for conceivable ruptures and exhaust valve Failures.

#### 9.7.9 Piping

Thick wall copper or stainless steel piping shall be used for all body and bogie mounted piping. It shall be electrically earthed and mounted in a robust manner.

Flexible tubing may be considered for use in selected areas of the Car interior but only if suitable maintenance access is provided.

Plastic piping, if used, shall only be used within the Car in areas, which are fully protected from Vandalism, possible impact and chafing.

Plastic piping shall not be used below floor level or for underframe equipment.

Quick release type fittings shall not be used on the Set.

#### 9.7.10 Compressor Duty

The mechanical auxiliary Subsystem shall have sufficient capacity to supply all Set air requirements both when running in Automatic Brake with 50 % of the compressors cut-out, whilst operating all stations around the City Underground, for a minimum period of 4 hours at this duty cycle and when running at any speed within the normal operating range over curved track that is at minimum standard.

9.7.11 Filtering and drying

The air shall be filtered within the main reservoir of the air compressor Subsystem and dried to ensure air system reliability. Contaminated condensate shall not be discharged to the Environment. Methods of condensate and dirt collection shall be submitted to RailCorp for review.

**9.8 Power Points**

A 240 volt General Purpose Outlet (GPO) shall be fitted at both ends of each upper and lower Saloon.

RFTA  
00253

All interior GPOs except those in the Crew Cabs shall have a level of protection not less than IP 54 defined according to AS4939 AS 60529.

All GPOs shall be provided with additional protection in the form of core balance or earth leakage protection devices.

**9.9 Flexible Hoses and Connections**

9.9.1 Flexible Hose

All flexible hose used between the body and bogie shall conform to the general requirements of FE 101.

9.9.2 Spanner Size

RFTA  
00070

All Flexible hoses for the tripcock hoses and emergency coupler MR & BP hoses shall be fitted with metal hexagon fittings, compatible with standard CityRail spanners carried in other rolling stock described in Appendix U - Train Emergency Equipment.

**9.10 Lighting**

9.10.1 General Lighting Requirements

Separate circuits shall be provided on each Car. These circuits shall supply feed to the following lighting:

RFTA  
00280

- a) Main Lights 

The main light circuits shall consist of the main passenger and gangway lights. Where all Passenger lights remain lit during Emergency Operation Stage 1 and Emergency Operation Stage 2, at least two separate circuits shall be provided within each Car.
- b) Emergency Lights 

Where all Passenger lights do not remain lit during Emergency Operation Stage 1 Lighting and Emergency Operation Stage 2 Lighting, The Emergency light Circuit shall consist of 2 stage emergency lighting:

- i) Emergency Passenger Stage 1 Lighting; and
- ii) Emergency Passenger Stage 2 Lighting.

- c) Local Lights 

The Local light circuit shall consist of the marker, Crew Cab, timetable, cupboard, coupler, step, Guard's Blue Light, emergency exit step, emergency exit ramp and Passenger exit lights

- d) Headlight 

Terminal end Cars shall be fitted with at least two headlights; and

RFTA  
00030

- e) Fog Lights 

Terminal end Cars shall be fitted with at least 2 fog lights, located below the level of the Driver's Cab floor. The fog lights shall be fitted with a flashing feature as described in RSU 650, receiving an input from the horn.

RFTA  
00111

All lighting, other than the head lights and fog lights, shall operate from power supplied by the lighting batteries and battery charging system.



9.10.1.1 Emergency Operation Stage 1 Lighting

Emergency Operation Stage 1 Lighting shall be when the EAPS lighting battery charging system supply is unavailable and the Set is not Stabled.

The following lights shall be available to be illuminated continuously:

- a) Crew Cab;
- b) Cupboard;
- c) Crew step;
- d) Coupler;
- e) Timetable;
- f) Marker;
- g) Guard’s blue light;
- h) Emergency exit and detrainment ramp lights;
- i) Main Passenger Lighting or Emergency Passenger Stage 1 Lighting; and
- j) Main Passenger Lighting or Emergency Passenger Stage 2 Lighting.

9.10.1.2 Emergency Operation Stage 2 Lighting

RFTA  
00110

RFTA  
00280

When the Set is not Stabled, Emergency Operation Stage 2 Lighting shall be available when the EAPS lighting battery charging system remains unavailable and the Emergency Stage 1 Lighting timer has expired.

In Stage 2 the following lights shall be available to be illuminated continuously before the battery is depleted to the point of low voltage cut out:

- a) Main Passenger Lighting or Emergency Passenger Stage 2 Lighting;
- a)b) Emergency exit and detrainment ramp lights;
- b)c) Train Marker Lights;
- e)d) Timetable lights; and
- e)e) Cupboard lights.

RFTA  
00140

After the low voltage cut out has activated, Train Marker Lights shall remain illuminated until the battery has no remaining charge.

9.10.1.3 Emergency Passenger Light Stages

RFTA  
00280

Emergency Passenger lights shall be provided by either dimming all lighting in the Passenger Areas or by selective illumination of lights to achieve the following illumination levels:

- (i) In Emergency Passenger Stage 1 Lighting the Passenger Saloon lighting illumination levels shall be an average of at least 75 lux and a minimum of 20 lux measured in the vertical median plane of each seat and along the Horizontal plane situated 0.80 m above the floor and 0.60 m from the back of each seat measured in accordance with UIC Code 555 clause 4.
- (ii) In Emergency Passenger Stage 2 Lighting the Passenger Saloon lighting illumination levels shall be at least 30 lux at stairs and exits, measured at floor level in accordance with UIC Code 555 clause 4.

9.10.2 Light Specification

RFTA  
00137

All light fittings shall meet the requirements of AS/NZS 60598. All light fittings shall comply with EN 60077 (Railway Applications - Electric Equipment for Rolling Stock) and EN 61373 (Railway Applications - Rolling Stock Equipment, Shock and Vibration Tests). Light fittings shall also comply with EN 60529 (Degrees of protection provided by enclosures) as specified under TPS.9.10.6 (AS 1939).

9.10.3 Local Light Protection

The individual Local Light circuits shall be protected from abnormal currents via separate Miniature Circuit Breakers.

9.10.4 Light Switching

Separate switching shall control each of the lights on the Local Light Circuits.

9.10.5 Lighting ~~Inverters~~ Equipment

RFTA  
00280  
  
RFTA  
00132

Where fluorescent lighting is used, each fluorescent light shall incorporate individual dc to ac inverter ballasts to power each fluorescent lamp. Inverter ballasts and any variation of fluorescent light illumination levels due to supply voltage variation shall be in accordance with RailCorp's Specification FE023-91.

Inverter ballasts shall not generate noise with excessive tonal components which individually or when combined with all other noise sources, exceeds the requirements of clause 6.2.19.

Where solid state lighting is used, the equipment shall meet the temperature and supply requirements of FE023 with no more than 10% change in illumination levels except when intentionally dimmed.

9.10.6 Lighting IP Rating

RFTA  
00253

- a) Interior - all interior lights shall have a level of protection of at least IP55 defined according to ~~AS1939~~ AS 60529.
- b) Exterior - all exterior lights and switches shall have a level of protection of at least IP66 defined according to ~~AS1939~~ AS 60529.

9.10.7 Lighting Illumination

Levels of illumination for the lighting shall comply with lux measurement according to UIC Code 555 clause 4.

The average and minimum illumination for each area shall be compliant with the average and minimum illumination for normal operation levels as set out in Table 11 below:

Location	Average	Minimum	Measurement taken from
Passenger Saloon (excluding the row of seats nearest the end of the Car in the Lower Saloon)	300 ± 50 lux	200 lux	along the vertical median plane of each seat and along the horizontal plane situated 0.80 m above the floor and 0.60 m from the back of each seat
Passenger Exit	n/a	150 lux	platform surface within a 1 m radius of a point located in the centre of the Passenger side door threshold and with no obstructions
Crew Cab	<b>180 ± 40 lux</b>	80 lux	Cab along the horizontal plane situated 0.80 m above the floor
Timetable Lights and task lights	n/a	80 lux	illuminate the flat area below the Crew's Timetable clip and other cab areas
Equipment Cupboard	n/a	100 lux	inside equipment cupboards, capable of illuminating the contents of each cupboard
Coupler Lights	160 lux	n/a	At the coupling equipment
Step Light	n/a	80 lux	within a 1 m radius of a point on the ground directly below the Crew Cab steps. The ground level shall be between 150mm to 170mm below ARL.
Guard Blue Light	40 Lux	n/a	1 m from the light source

Location	Average	Minimum	Measurement taken from
Marker Light	40 Lux	n/a	1 m from the light source

**Table 11: Average and Minimum Illumination**

**9.11 Passenger Lights**

9.11.1 Passenger Light Operation

The Passenger lights shall switch on automatically when the lighting battery is being charged if the Set is in the Normal mode.

It shall be possible for the Crew to remotely turn on all Passenger lights simultaneously in normal operating conditions.

When the supply is below normal operating parameters and/or there is an operational Fault the conditions set out below shall be achieved:

9.11.1.1 Passenger Lights On - Charging

Operating the Passenger lights On push button shall turn on main Passenger lights when the associated lighting batteries are being charged and if the Set is not Stabled.

9.11.1.2 Passenger Lights On - Battery

Operating the Passenger lights On push button shall turn on Emergency Passenger lighting Passenger Stage 1 Lights and Emergency Passenger Stage 2 Lights when the associated lighting battery's voltage is above the battery low voltage cut-out level and if the Set is not Stabled.

9.11.1.3 Emergency Lights Condition

Passenger lighting shall be maintained at normal operating levels for 15 seconds following the failure of the battery charging system. If the battery charging system restarts within this time, When the battery charging system is inoperative the Passenger lighting shall extinguish after 15 seconds and automatically revert to condition described in clause 9.11.1.1 (Passenger Lights On – Charging) of this RailCorp Train Performance Specification when the battery charging system re-starts. If the battery charging system does not restart within this time, the Passenger lighting shall switch to the condition described in clause 9.11.1.2 of this RailCorp Train Performance Specification.

9.11.2 Main and Emergency Light Protection

Passenger lighting circuitry The main passenger lights circuits shall be protected from abnormal currents via a separate Miniature Circuit Breakers and allow fault discrimination from the power source. Lighting circuits shall be arranged such that no single fault downstream from the Miniature Circuit Breakers and including the Miniature Circuit Breakers shall result in illumination less than that required for Emergency Passenger Stage 1 Lighting in any Car.

9.11.3 Emergency Light Protection Not Used

~~The emergency passenger lights circuits shall be protected from abnormal currents via a separate Miniature Circuit Breaker.~~

9.11.4 Passenger Lighting Fixtures

The Passenger lighting shall be arranged to provide continuous illumination behind the diffusers.

The Passenger lights shall have no gaps or voids around the housing in order to resist tampering and Vandalism.

RFTA  
00280

### 9.12 Passenger Exit Light

Passenger exit lighting shall be provided at each Passenger side door. The light shall not visually hinder Passengers using the doorway. It shall be positioned in a way so that it does not point directly into Passengers eyes.

#### 9.12.1 Passenger Exit Light Area

The Passenger exit lights shall illuminate the door threshold and the platform surface within a 1m radius of a point located in the centre of the Passenger side door threshold.

#### 9.12.2 Passenger Exit Light Timing

The Passenger exit lights shall illuminate as the door opens.

The Passenger exit lights at each individual doorway shall switch off when the individual Passenger side doors are fully closed.

#### 9.12.3 Passenger Exit Light Location

The Passenger exit lights shall be located no higher than 300 mm above the floor, shall be protected from Vandalism and not lit when the Passenger doors are closed and interlocked.

### 9.13 Cupboard Lights

Lights shall be provided in each equipment cupboard, which shall operate when the cupboard door is opened.

### 9.14 Crew Lights

The Crew Cab lighting shall be controlled by a push button, multiple way switching, located on the Driver's Workstation, the Guard's Workstation and within the Crew Cab at the Driver's and Guard's side doorways. The Crew Cab lights shall turn on when the external step light is operated, to assist Crew access.

#### 9.14.1 Crew Cab Lights

The Crew Cab lights shall be individual fluorescent light fittings shall be recessed in into the cab ceiling panels.

RFTA  
00246

### 9.15 Timetable and Task Lighting

Timetable and task lights shall be provided in each Crew Cab, with a provision that in the Driver's Cab it shall be possible for the Guard, the Driver or both to illuminate the Timetable and other areas of the cab.

Details of the task lighting including switching, fitting type and area coverage shall be determined during the Contract. Task lighting shall be adequate to enable Driver and Guard to carry out all normal activities especially when the Set is moving between stations without turning on the general cab lighting.

### 9.16 Guards Blue Light

An identifying Guard's blue light shall be fitted above all Crew Cab side doors on the Car exterior.

The Guard's blue lights shall be illuminated only on the Crew Cab where the Guard's Station is activated.

The Guard's blue light shall cycle on and off to approximately 1 Hz on any Crew Cab where unauthorised access has occurred and a TOS indication shall be provided to the Crew.

### 9.17 Step Light Illumination

Crew Cab step lights shall remain operable in any operational state (see clause 5.4) and shall be operated via multiple way switching. The light shall remain illuminated for at least 20 minutes after stabling of the Set unless manually switched off by means of the step light switch. Each step tread shall be illuminated.

Step Light Switch Location

RFTA 00087	<p>a) Interior - shall be located on the Driver's Workstation, the Guard's Workstation and internally at the Cab side doors; and</p> <p>b) Exterior - shall be mounted on the body fixed externally located within reach of a person standing at the trackside directly in line with the Crew Cab steps or alternatively may be integrated with the external Cab access lock.</p>
---------------	---

**9.18 Emergency Passenger Lights**

RFTA 00280	<p>The Emergency Passenger <del>Stage 1</del> Lights and Emergency Passenger <del>Stage 2</del> Lights shall be operable with the battery charging system inoperative, provided that the lighting battery voltage is maintained above the battery low voltage cut out level.</p>
---------------	--

**9.19 Emergency Step and Ramp Light Illumination**

RFTA 00109	<p>The emergency steps, <u>the terminal end emergency access doorway</u> and emergency ramp shall be provided with illumination to enable their use and to enable persons to move clear of the steps and ramp. The emergency step and ramp light shall remain operable whenever the Set is not stabled <del>and shall be operated by a switch mounted on the fixed exterior of the Car body, within reach of a person standing at the track level directly in line with the emergency exit steps.</del></p> <p>The emergency step light shall be illuminated automatically on opening of each local Emergency Door. <u>The terminal end emergency access doorway ramp light shall be illuminated automatically on opening of the terminal end emergency access door. The emergency detrainment lights for the ramp shall be illuminated automatically on deployment of the terminal end emergency detrainment ramp.</u></p> <p><u>The number of lights, the mounting location, angle and level of illumination shall be demonstrated on the emergency detrainment ramp prototype.</u></p>
---------------	---

**9.20 Headlights**

RFTA 00032	<p><u>Headlights requirements in this section reflect the technical characteristics of the current GE sealed beam headlights installed in the existing RailCorp rolling stock fleet. Alternative technologies may be used when supported by technical justification including risk assessments and trade-off studies as appropriate.</u></p>
---------------	--

9.20.1 Headlight Low Beam

Each headlight shall have a low beam providing not greater than 20% of the rated light output of the headlight.

9.20.2 Headlight High Beam

Each headlight shall have a high beam providing the full rated light output of the headlight.

9.20.3 Headlight Lamp

Each headlight lamp shall meet the following criteria: a minimum of 270,000 candela peak centre beam power, 9 degrees vertical beam spread tilted downwards, 9 degrees horizontal beam spread and a rated life greater than 500 hours.

9.20.4 Headlight Focus

The headlight beam pattern shall be focused on the track ahead such that they do not shine directly onto oncoming trains passing on level Tangent Track.

9.20.5 Headlight Control

The headlights shall be operated by a single control.

The headlight control shall switch sequentially from OFF to LOW beam to HIGH beam to LOW beam to OFF using a rotary switch.

Continuity of illumination shall be provided when switching the headlights from low to high beam.

RFTA  
00029

Both high and low beam headlights shall remain operational so long as one Electrical Auxiliary Power Supply remains operational within its local 4 cars.

A headlight high beam Failure indicator shall be provided, to indicate to the Driver Failure of each headlight's high beam.

Two headlight circuit breakers shall be provided one each for high beam and for low beam.

## 9.21 Fog Lights

### 9.21.1 Fog Light Lamp

The lamp assembly shall produce a fog light distribution compatible with ADR 50/00. The luminous flux shall be not less than 1750 lumens. The rated life shall be not less than 150 hours.

### 9.21.2 Fog Light Focus

The fog light beam pattern shall be focused on the track ahead such that they do not shine directly onto oncoming trains passing on level tangent track.

### 9.21.3 Fog Light Circuit Breaker

Circuit Breaker protection against abnormal currents shall be provided for the fog light circuit.

### 9.21.4 Fog Light Lens

The fog lights shall have clear, non-tinted lenses.

### 9.21.5 Leading Car Fog Light

The leading Car's fog lights shall remain operable as long as one EAPS power supply is available on the Set.

## 9.22 Marker Lights

Two twin marker lights shall be fitted to the terminal end of each terminal end Car. Each twin marker light shall provide one white and one red array.

The Marker Light control shall switch sequentially from OFF to RED ON to OFF to WHITE ON using a rotary switch.

### 9.22.1 Location and Orientation

The marker lights shall be positioned to indicate the upper and side extremities of the terminal end Cars. If the marker lights are mounted with the twin lenses side by side, the red lens or array shall be towards the outside of the Car. If the marker lights are mounted with the twin lenses one on top of the other, the red lens or array shall be on the top.

### 9.22.2 Marker Lamp Axis

RFTA  
00031

The marker lamp assembly shall be mounted so that the axis of the beam is parallel to the Car's Longitudinal axis. The marker light shall be viewable from up to ~~80~~75° from the principal axis.

### 9.22.3 Marker Lamp Light Seal

An effective light seal shall exist between the red and white marker lights such that light cannot pass from either light to the other.

### 9.22.4 Marker Lamp Light Output

The marker lamp shall have a nominal light output of 40 lux at 1 metre.

**9.23 Coupler Lights**

Coupler lights shall be provided to illuminate the terminal end couplers, jumper, pneumatic cocks and other coupling equipment and shall be controllable from the Driver's Workstation.

**9.24 Lighting Controls**

RFTA  
00280

Operation of the carriage isolate function shall switch off main passenger, emergency passenger lights stage 1 & 2, passenger exit, and emergency exit lights on the selected Car.

Operation of Guard's isolate cancel function shall switch on main Passenger lights, ~~Emergency Passenger lights Stage 1, Emergency Passenger Stage 2~~ and emergency exit lights on the selected Car.

Operation of the Guard's isolate cancel function on an "all" position shall switch on main Passenger lights, Emergency Passenger lights Stage 1, Emergency Passenger Stage 2, and emergency exit lights in all Cars.

RFTA  
00280

Operation of the pantograph up push button shall switch on all main Passenger lights, Emergency Passenger ~~lights Stage 1, Emergency Passenger Stage 2~~, and emergency exit lights of all Cars that are not isolated if the battery charging system is operational.

**9.25 Heating Ventilation and Air Conditioning**

RFTA  
00068

The Heating Ventilation and Air Conditioning (HVAC) Subsystem shall control internal environmental parameters to provide a comfortable surrounding for Passengers and Crew throughout the range of conditions defined for the external environment. The criteria for assessing the performance of the HVAC Subsystem shall include user comfort (as defined below in clause 9.25) and minimal noise (as required by clause 6.2.19).

For external shade temperatures up to 23 degrees Celsius, the temperature in the Passenger area shall be maintained at between 18 and 23 degrees Celsius under a typical peak period operating scenario up to loading condition AW2.

As the external shade temperature rises between 23 and 35 degrees Celsius, the maximum temperature in the Passenger area shall be allowed to rise in proportion on a linear basis from 23 to 28 degrees Celsius under a typical peak period operating scenario up to loading condition AW2.

For external shade temperatures of 35 degrees Celsius and above, the maximum temperature in the Passenger area shall be maintained at 28 degrees Celsius under a typical peak period operating scenario up to loading condition AW2.

The temperature shall be thermostatically controlled on a Car by Car basis and temperatures within the Passenger area allowed to vary between the maximum and minimum limits to minimise the need for heating and cooling. Relative humidity in any given Car shall not exceed 60%, except under emergency ventilation conditions.

The internal design of the Set shall be free from draughts. The maximum air velocity impinging particularly on seated Passengers shall not exceed 0.4 m/s.

HVAC circuitry and components shall not run directly from the Main Power Supply. There shall be no 1500 V equipment used in the HVAC Subsystem.

RFTA  
00050

The static pressure inside each Car shall be maintained at a slight positive pressure relative to atmosphere, ~~that will not lead to an increase in the forces required to operate any doors in the Car.~~ The door operation shall not be adversely affected by car pressurisation levels.

**9.25.1 Inlet Fresh Air**

Fresh air shall be drawn from an area where there is no possibility that the air has been heated by Set borne equipment. The fresh air duct design shall prevent the ingress of water and debris.

---

A fresh air damper shall be fitted to all air intakes to positively prevent smoke and fumes entering the Car interior, for example while in a tunnel.

The fresh air supply shall deliver fresh air to Passenger areas at a rate not less than 0.21m<sup>3</sup>/minute/Passenger.

#### 9.25.2 Temperature Control / Air conditioning Synchronisation

There shall be no possibility of separate air conditioning units within the same Car working against each other (i.e. one air conditioning unit in heating while the other is in cooling).

#### 9.25.3 Failed Air Conditioning Unit

In the event of a unit Failure, the airflow in the working unit or units on the Car shall increase to compensate for the failed unit.

#### 9.25.4 Heat Loading

The loading for the HVAC Subsystem when cooling shall be designed under AW3 load and under all environmental conditions.

The loading for the HVAC Subsystem when heating shall be designed for an empty Car under all environmental conditions.

#### 9.25.5 Heating or Cooling Recovery

The temperature within the Passenger and Crew areas shall be within  $\pm 2$  °C of the set point temperature within 30 minutes of being taken out of the Stabled state.

#### 9.25.6 Code of Practice

PPP Co shall follow HB40-1992 "Australian Refrigeration and Air Conditioning Code of Good Practice" or an approved equivalent International Standard.

#### 9.25.7 Refrigerants

A label displaying the refrigerant type employed shall be permanently affixed in close proximity of refrigerant charging points (if required) and be clearly visible.

#### 9.25.8 Filter Standard

Air filters shall comply with AS 1324.1 and AS 1324.2. Oil wetted filters shall not be acceptable.

#### 9.25.9 Mode Indication

The air conditioning units shall indicate to Crew and maintainers, both locally and remotely, the current mode of operation.

#### 9.25.10 Fault Indications

Any Fault condition on the unit shall be indicated both locally and remotely to the Driver. The Driver's remote indication shall identify the defective unit, detail the type of Fault and the action required. The local fault indicator shall indicate that a Fault exists on that unit and the action required. Fault indications shall "latch on" until reset.

#### 9.25.11 Fault Reset

The Driver shall be able to reset Faults from the Crew Cab.

Local reset push buttons shall be provided within the Car and located with the other local air conditioning controls.

The design of the reset function shall be such that it is not possible to continually over-ride any protective device by continuous operation of the reset device.



#### 9.25.12 Control Location

The local controls for the air conditioning unit shall be located in a clean filtered air environment.

#### 9.25.13 Filter Hatches

Any internal hatches within the Car shall not present a hazard to Maintenance Staff or Passengers. The hatches shall be designed such that in the event of a restraint Failure, the hatch does not drop open. A safety catch at an intermediate position, operated independently from the main catch is preferred.

#### 9.25.14 Air Distribution

The design of the air distribution duct work and diffusers shall be such that all parts of the Passenger and Crew areas receive an appropriate share of conditioned air depending on the likely number of Passengers while maintaining an acceptable temperature variation within the Car. The range of this temperature variation should preferably not be more than 2°C and shall not exceed 4°C when measured at any point on a horizontal plane half way between the floor and ceiling in all Passenger areas. Dead spots shall be avoided. The design of the Set shall minimise the formation and accumulation of condensation on internal surfaces.

#### 9.25.15 Drip trays and drainage

Air conditioning units and duct-work shall drain any accumulated water. Water shall not drain onto any equipment or to the interior of the Car. The design of drains shall ensure they cannot be blocked by debris. Drains shall not direct water onto Passengers on platforms or in doorways.

#### 9.25.16 Bodyside Doors and Air Movement

The HVAC Subsystem design shall incorporate the opening/closing duty cycle of the Passenger bodyside doors and adjust its performance for the following operational conditions:

- a) The external Passenger bodyside doors are fully open on one side for extended periods (20 minutes or more); and
- b) When the Passenger bodyside doors are repeatedly opened and closed, fully open for 30 seconds within each 2 minutes.

#### 9.25.17 Intercar Doors and Air Movement

The HVAC Subsystem operation with intercar access doors open shall ensure that there is no unbalancing or detrimental effects between the Cars in respect to temperature regulation or air distribution.

#### 9.25.18 Interface to Auxiliary Power Subsystem

##### 9.25.18.1 Intermittent Main Power Losses

Following intermittent losses of power, the air conditioning unit shall automatically return to its last operational mode with the restoration of power.

##### 9.25.18.2 Emergency Ventilation

In the event of a power Failure to all air conditioning units exceeding 2 minutes, a minimum of 1000 litres/second of fresh air shall be introduced to the Car and distributed evenly through the Passenger areas. This is not expected to be cooled air. The Set shall be able to maintain this air supply for at least 1.5 hours.

##### 9.25.18.3 HVAC Main Isolation

Means shall be provided to separately isolate all electrical power and control from each the HVAC unit's power and control plugs. HVAC Circuit Breakers for each three phase mains, DC power and control circuit shall not be ganged together. Each three phase mains Circuit Breakers providing shall be ganged with each separate HVAC unit being fed from a separate isolation device to ensure all three phases of that mains are disconnected in one action. The separate isolation devices for each HVAC unit's power and control plugs shall be logically grouped and clearly identified.

RFTA  
00242

9.25.19 Crew Cab Subsystem

9.25.19.1 Cab Area HVAC

It shall be possible for the Crew to vary the temperature setting in the Cab (both heating and cooling). With the Crew Cab doors and windows closed, the HVAC Subsystem shall maintain the temperature in the Cab area selected by the Crew. The temperature setting shall be variable nominally throughout the range 18 °C to 23 °C considering the off-temperature set point of the Passenger HVAC Subsystem. The HVAC air outlets shall be provided in the ceiling. The outlets shall be fitted with a directional and flow rate control. The flow control shall allow for manual adjustment from zero flow to full flow with a minimum of five intermediate positions. The controls shall be of robust design.

The maximum airflow into the Crew Cab shall be not less than 150 litres/s, which shall be maintained during the Failure of one HVAC unit or fan.

RFTA  
00314

The Cab HVAC equipment shall maintain control settings in memory. At Cab activation the Cab HVAC equipment shall continue operation and initially use the last remembered crew settings. At Cab de-activation the Cab equipment shall continue operation and initially use the default automatic settings of conditioned air, temperature set point as set by the ambient conditions and automatic air flow rates. When starting from Stabled the Cab HVAC equipment shall turn on automatically and shall begin operation at the default automatic settings of conditioned air, temperature set point as set by the ambient conditions and automatic air flow rates last remembered settings.

9.25.19.2 Crew Heaters

Heaters in addition to those provided with the main HVAC unit shall be provided in the Crew Cab. This control shall allow for at least two stage heating in the Cab area by way of fan-forced resistive heaters. The location of the heaters shall be in the vicinity of the Driver's and Guard's Workstations. The heater control shall allow for equivalent control of the heaters from switches mounted on each of the Driver's and Guard's stations.

The heaters shall not provide ledges under which items may be wedged that could be used to circumvent any safety device.

9.25.19.3 Thermal Output

When heating, the thermal output of the Crew heaters shall be not less than 2 kW. The minimum output of any individual heater shall be not less than 1 kW. All resistive heating elements shall be placed such that in normal operation no surface could burn a Passenger or Crew member in full contact with the heater.

9.25.19.4 Crew's Fresh Air

A source of fresh air separate from the Car HVAC unit shall be provided to the Crew. The outlet shall be fitted with controls for direction and flow rate. The air supply shall be provided by a two-speed fan. A means of positively adjusting the air supply shall be provided. The minimum fresh air flow rate into the Crew Cab must be 0.84 m<sup>3</sup>/minute.

## 10 Traction and Braking System

### 10.1 Dynamic Performance

The Set shall achieve the following specified performance in all conditions including and between AW0 or AW3 loaded conditions.

#### 10.1.1 Speed

The Set shall operate in 3 differing operational speed modes:

- a) Normal operation (This operational mode shall be assumed unless otherwise stated.);
- b) Washing; and
- c) Emergency (get home).

##### 10.1.1.1 Normal Operating speed

The Maximum Operating Speed of the Set shall be 130 km/h. The Design Overspeed shall be not less than 110% of the maximum operating speed.

##### 10.1.1.2 Washing Speed

The nominal Set washing speed shall be 3.5 km/h. When washing speed is selected, using the Set washing speed control function, the Set shall accelerate up to and maintain this speed on any uphill gradient track up to a maximum of a 2% grade.

##### 10.1.1.3 Emergency (get home)

The driving control configuration shall be such that no single point Failure within the traction and brake controller shall render the Driver to be unable to control traction and braking from the leading Cab. This functionality may be provided by a “get home” switch in the Cab that will enable the Power/Brake Controller to provide power and braking in a manner independent of any encoding device. This may be achieved by enabling the Power/Brake Controller to provide a Jerk limited on/off traction control and only Automatic Brake control or by other means. The get home facility shall only be available when the Master Control Switch and Reverser Handle are fully operable and in a condition that would in normal circumstances allow the Power/Brake Controller to demand traction and braking. If such a switch is provided then the Set shall be able to start on the steepest gradient and the maximum rate of change of acceleration shall not exceed the limit set elsewhere in this RailCorp Train Performance Specification.

The following features shall be provided with the *get home* facility:

- a) Each use of the get home facility shall be logged on the Event Recorder and shall be displayed prominently on TOS screens for both Driver and Guard, with an accompanying audible alert tone;
- b) The switch shall latch in the selected position, either “Normal” or “Emergency”;
- c) The get home facility shall only be available from the Active Driver’s Cab;
- d) The get home facility shall not be available if a fault is present with the Brake demand system from the Active Driver’s Cab, or if the Active Driver’s Cab has braking in any way isolated; and
- e) Acceleration shall not exceed Level 1 acceleration as defined in this RailCorp Train Performance Specification.

#### 10.1.2 Acceleration

On level track the Set shall have two levels of normal performance as detailed in Appendix V – Acceleration Performance.

##### Level 1 performance

- a) Initial acceleration up to 30 km/h at  $0.8 \text{ ms}^{-2}$ ; then
- b) Constant power acceleration up to 80 km/h.

##### Level 2 performance

RFTA  
00284

- c) Initial acceleration, up to the same constant power as Level 1, at  $1 \text{ ms}^{-2}$ . This acceleration shall be re-programmable to reduce from  $1.0 \text{ ms}^{-2}$  at 0 km/h to  $0.8 \text{ ms}^{-2}$  at 28 km/h at RailCorp’s request; then
- d) Constant power acceleration (consistent with Level 1 performance) up to 80 km/h.

RFTA  
00255

Under both scenarios the Set shall be capable of accelerating beyond the Design Overspeed but shall be limited such that acceleration is tractive effort shall be ramped off beyond from 137 km/h to zero at Design Overspeed.

PPP Co shall switch the Sets between these two performance levels at RailCorp’s request.

RFTA  
00284

The Set Level 1 performance on rising gradients shall be as shown in Appendix V – Acceleration Performance. PPP Co shall develop the Set Level 2 performance on rising gradients.

10.1.2.1 Washing Acceleration

The Washing acceleration shall be set at a default of  $0.22 \text{ ms}^{-2}$ , when measured using a AW0 Set mass on level track.

10.1.3 Deceleration

The braking deceleration performance under test conditions for each type of braking shall be as set out in Table 12 below:

Braking Type	Average Deceleration Rate $\text{m/s}^2$	Speed km/h Initial Speed Range	Max Blending Transition Variation $\text{m/s}^2$	Brake fill time to 95% of max	Brake release time to 30 kPa cylinder pressure
EP	0.95 - 1.00	> 40 & < 130	$\pm 0.08^{\text{e}}$	2.0 - 2.5 s	2.5 - 3.5 s
Automatic	0.90 - 1.05	> 80 & < 130	N/A	<del>=&lt; 3.5 s</del> <u>3.0 - 5.0 s</u>	=< 15 s
Emergency <sup>1</sup>	1.10 - 1.30	> 60	<del>0*</del> <u>+Max dip</u> 0.04*	=< 5 s <sup>1</sup>	=< 30 s
Parking Brake	Instantaneous > 0.4	N/A	N/A	N/A	N/A

RFTA  
00059

RFTA  
00059

RFTA  
00059

~~\* i.e. there shall be no decrease in the absolute value of deceleration (the deceleration rate shall not move closer to zero).~~

\* i.e. During the transition to Emergency braking from Blended Braking the instantaneous deceleration rate should only increase (i.e. should only move further away from zero) and it shall not reduce (i.e. shall not move closer to zero) by more than  $0.04 \text{ m/s}^2$ .

<sup>1</sup> measured using each of the Power/Brake Controller, the trip cock, the Driver’s Safety System penalty application and the emergency brake pipe cock in the lead Car.

<sup>e</sup> measured over any one second period after 95% of the demanded deceleration rate has been established, under conditions of constant brake demand and dry track.

**Table 12: Deceleration Rates for Modes of Braking**

Throughout a constant application of the brakes until the Set is stationary, the instantaneous deceleration shall be not less than 80% of the peak instantaneous deceleration initially achieved.

The Emergency Brake performance shall enable the Set to stop within the distances shown in RSU 160 figure 1 for a High Speed Passenger Train.

10.1.3.1 Braking Performance Calculation

PPP Co shall provide brake performance calculations of the stopping distance and instantaneous deceleration rate at speeds up to the Maximum Operational Speed, and 10% over speed for the following braking modes:

- a) Service Brake including Electric Brake;
- b) Service Brake excluding Electric Brake;
- c) Automatic Brake;
- d) Emergency Brake, initiated by a Train Stop;
- e) Emergency Brake, initiated by Driver control; and
- f) Park Brake.

The average deceleration rate shall be determined as follows:

$$d = v^2 / (2 * s - v * t) - 9.8 / G$$

where:

- d = deceleration (m/s<sup>2</sup>)
- v = initial velocity (m/s)
- s = measured stopping distance (m)
- G = Gradient (1 in G)
- t = fill time correction (seconds)
  - = 1.6 sec for application involving EP Brake
  - <= 3.5 sec for purely Automatic Brake application

The gradient G is positive (G > 0) for an ascending incline or negative (G < 0) for a descending incline.

10.1.4 Maximum Longitudinal Jerk

The maximum Longitudinal Jerk produced by the Set during acceleration or deceleration shall be less than 0.7 m/s<sup>3</sup> except under Emergency Braking when the Longitudinal Jerk shall not be greater than 1.0 m/s<sup>3</sup>. Any Longitudinal Jerk with a duration of 0.5 s or less shall not be subject to this requirement.

10.1.5 Bogie Brake Gauges

For Cars with Cabs, it shall be possible to constantly monitor the brake cylinder pressure in each bogie of the Car, from the Crew Cab. This shall be achieved by the inclusion of pressure displays provided on the Drivers Workstation or on the TOS screen.

Cars without a Cab shall be fitted with a gauge system that can be viewed by Crew within the Car, but cannot be viewed by Passengers.

10.1.6 Roll-back Prevention

A Set while in any loaded condition from AW0 to AW3 load, and standing on any grade from level to a maximum of 1 in 4325; and with the EP Brake or Automatic Brake applied at any position sufficient to hold the Set on the grade; shall not roll-back (i.e. roll against the intended direction of travel for a distance greater than specified in the two following paragraphs) as the combined controller is moved normally from the brake position to ~~any off-coast or~~ the traction position when starting the Set on a grade. Normal movement of the combined controller is defined to be a smooth and continual movement as used in a normal driving technique. The releasing of the brakes and application of traction power shall be matched to ensure that forward movement is achieved without activating the roll-back prevention facility and without the need to apply the Park Brake. If the Driver only moves the combined controller to the minimum traction

RFTA  
00066

position, it will be acceptable that the Set may rollback on gradients steeper than 1 in 43, and that if so a brake application will be triggered.

In the event of Set movement opposite to the direction set by the Driver the Set EP Brake shall apply automatically to stop the roll-back within a total displacement equivalent to less than 1/2 wheel revolution under all conditions anywhere on the Rail Network. Release of the anti-roll-back brake application shall require the Power/Brake Controller to be moved into a braking position before reapplying power.

In the event of the normal EP Brake being non-operational, an emergency a brake application of the Automatic Brake sufficient to stop an AW3 loaded Set on a maximum 1 in 25 grade shall be initiated if the roll-back distance exceeds the equivalent of one wheel revolution.

The Driver shall be alerted by the TOS in the event of activation of the roll-back prevention facility.

## 10.2 Traction

RFTA  
00098  
00105

The traction subsystem shall comply with ~~IEC 77~~ IEC 60077 except electrical creepage and clearances, which shall comply with BS2618 except where otherwise stipulated in this RailCorp Train Performance Specification.

### 10.2.1 Traction Control

The traction demand shall be controlled only from the Driver's Workstation in the Active Driver's Cab.

In addition to the traction equipment having an automatic reset capability should it be required by RailCorp at the design stage there shall be a Crew traction reset function, which shall be controlled from the Driver's Workstation.

### 10.2.2 Traction Faults Recorded

All traction Subsystem faults shall be recorded by the TOS within 1 second of occurrence.

### 10.2.3 Motor Cut-Out Operation

RFTA  
00340

Any combination of traction motor groups shall be able to be cut in or out from an active Driver's Workstation via the TOS screen only when in maintenance mode.

The Driver shall not be able to cut traction motors in or out whilst powering or Electric Braking.

With not less than one motor car (or the equivalent number of motors or traction packages) cut out the Set shall be able to meet the notional run time requirements included in Appendix C – Routes and Timings. In addition, the Set shall be capable of running at maximum capability with not less than one motor car (or the equivalent number of motors or traction packages) cut out.

With not less than two motor cars (or the equivalent number of motors or traction packages) cut out an AW3 loaded Set shall be able to operate an all stations run pattern without overheating the traction equipment when using maximum available traction and braking.

### 10.2.4 Step Voltage Changes

The traction Subsystem shall remain in control, without tripping out, for a minimum OHW exponential voltage change of  $\pm 450$  Volts in 68 ms. The time constant for the curve shall be taken as 16.7 ms.

Protection shall isolate the traction Subsystem during regenerative braking if an earth fault is detected on the OHW. The trip level for protection is that the rate of reduction of OHW voltage exceeds 450 Volts in 68 ms for a 16.7 ms inductive time constant of the OHW supply. RailCorp is open to discussion on this issue during the Contract if a better trip performance can be provided.

### 10.2.5 Over Voltage Protection

Protection shall be provided to isolate the traction Subsystem when the OHW voltage exceeds 2050 V with respect to the rail in traction or braking.

The over voltage protection shall reset automatically when the Main Power Supply voltage falls below 1850 V and traction or regenerative braking shall be re-enabled.

10.2.6 Low Voltage Performance Limiting

Traction current draw for OHW voltages below 1450 V shall drop linearly down to 73 % of the 1450 V value for a line voltage of 1100 V below which traction line current shall drop linearly down to zero at 1000 V.

Protection shall be provided to switch off the high voltage traction Subsystem circuits when OHW voltage falls below 1000 Volts and power shall not be re-applied until the OHW voltage exceeds 1100 Volts.

An audible and visible alarm shall indicate to the Driver when the voltage on the OHW is insufficient for traction.

10.2.7 Adjustable Power Draw

The Set shall be able to automatically adjust the performance level to limit the maximum current drawn along certain track sections within the network. At least two different values of a single limiting parameter (maximum current draw for the Set) shall be configured and the lower value shall be selectable for each track section where reduced current draw is defined by RailCorp. RailCorp will advise the locations of relevant track sections and the limiting parameters during the Contract Term. RailCorp will advise during the Contract Term the locations of the relevant track sections where the single limiting parameter will apply. and It shall be possible for these parameters and the locations to be re-configured at nil cost to RailCorp during the life of the Set.

RFTA 00169
RFTA 00169

10.2.8 Degraded Mode Performance

An AW3 loaded Set with 2 traction inverters cut-out or a loss of 50 % traction inverters, whichever represents the greater loss, shall be able to perform the following one-off service patterns without meeting timetable but without over-heating or damaging any traction equipment starting at normal operating temperature:

- a) All-stations on the Bankstown loop, either direction; and
- b) All stations Hornsby - Epping - Chatswood - Central - Redfern - express to Burwood - Strathfield - Epping - Hornsby, either direction.

An empty Set shall be able to travel at a speed not to exceed 25 km/h with one traction package cut-out (i.e. both inverters & traction motors cut-out) without overheating any traction equipment, from the lowest point on the Epping - Chatswood line at Lane Cove River to either:

- c) Chatswood & then reversal to Hornsby Maintenance Centre; or
- d) Delhi Road and on to Hornsby Maintenance Centre.

10.2.9 Push out performance

An AW3 loaded Set shall be able to push out a failed AW3 loaded, eight-car train of 430 tonnes tare or Set, whichever is the heavier, from the lowest point on the Epping – Chatswood line at Lane Cove River to each of Chatswood and Delhi Road stations and beyond, without overheating any power and traction equipment.

For the pushing train a minimal cool-down time from in-traffic service shall be allowed. This shall be represented by no more than 3 minutes standing time at a signal 1000 metres behind the failed train followed by closing up the distance at 25km/h using regenerative brakes down the respective grade approaching the failed train, stopping and coupling up followed by immediate push-out.

As a minimum, each Set must be able to achieve push-out requirements in accordance with the following scenarios:

- a) For a failed train on the UP line, the following assumption is to be used:
  - i) The front of the failed train is at the start of the approximate 2.7% grade that climbs 3.5km up towards Chatswood station;

- 
- ii) The failed train is to be pushed up to Chatswood station where both trains are emptied of Passengers; and
  - iii) 7 minutes after arrival at Chatswood station, the assisting train is to pull the failed train up the North Shore line to Hornsby Maintenance Centre.
- b) For a failed train on the DOWN line, the following assumption is to be used:
- i) The front of the failed train is at the start of the approximate 2.8% grade that climbs 1.6km up towards Delhi Road station;
  - ii) The failed train is to be pushed up to Delhi Road station where both trains are emptied of Passengers; and
  - iii) 5 minutes after arrival at Delhi Road station, the assisting train is to push the failed train up the remainder of the Epping-Chatswood Rail Link and then the Main North line to Hornsby Maintenance Centre.

Simulations of the two push-out scenarios above shall be provided. The simulations shall include plots of speed and temperatures for traction motors and traction inverter equipment.

#### 10.2.10 Earth Fault Protection

Earth fault protection shall be provided to protect the equipment in the event of high-voltage traction equipment earth faults.

#### 10.2.11 Traction Circuit Galvanic Isolation

The high voltage traction circuit shall provide galvanic isolation not less than 8 kV (peak) from the Low Voltage and Extra Low Voltage traction circuits.

#### 10.2.12 Line Input Impedance

The 50Hz line to rail input impedance of the Set shall be greater than 0.5 ohms at all times.

#### 10.2.13 Low Pass Line Input Filter

The line input filter components shall be chosen to optimise the functions of providing a low impedance source for the traction converter, a high input impedance to the power frequency and its harmonics and attenuation of traction inverter generated ripple.

The filter together with the traction Subsystem shall provide a cut off frequency less than 40Hz when both unloaded and loaded and for any values of conduction ratio.

Fuses shall not be used in the traction high voltage circuits.

#### 10.2.14 Solid State Traction Overload Protection

In the event of a traction fault, semiconductor protection shall cut off power, so as to avoid tripping the HSCB where possible.

Semiconductor protection shall include predictive tripping before Fault levels that may damage equipment are reached. Nuisance effects of the protection shall be minimised by automatically resetting where possible, subject to a maximum of 3 cycles in succession over a short time period. PPP Co. shall propose the time period for acceptance by RailCorp.

#### 10.2.15 Isolating Line Contactors

Contactors shall be provided to isolate the traction inverter equipment and traction motors for each traction motor group.



10.2.16 Resistor Rating

High voltage resistors shall be rated and force ventilated if required to ensure that overheating does not occur whilst operating under the worst supply conditions in conjunction with the worst environmental conditions in this RailCorp Train Performance Specification.

RFTA  
00080  
00081

10.2.17 Inverter Equipment

The traction Subsystem inverter equipment shall be in accordance with IEC 4287 61287 and IEC 446 60146 except where modified by this RailCorp Train Performance Specification.

10.2.17.1 Inverter Temperature Rise

PPP Co shall establish that the actual maximum temperature rise of the inverter, traction motors and brake resistors filter inductor on simulated running load test does not exceed the design figures quoted.

10.2.17.2 Inverter Cooling

The traction equipment cooling should ideally use natural ventilation; should additional cooling be required then forced ventilation shall be used.

10.2.18 50 Hz Detection System

A high integrity 50 Hz line current ripple detection system shall be provided to isolate the traction circuit or other faulty equipment whenever excess 50 Hz line ripple current is detected. The 50 Hz detection system shall achieve high levels of reliability. The filter charging inrush current of electrical equipment shall not generate 50 Hz harmonics capable of affecting RailCorp’s track circuits. Requirements of r50 Hz detection are shown in Table 13 below:

<b>Detection</b>	<b>Level</b>	<b>Time period</b>
<i>50Hz Detection System Operating Level</i>	<i>1 A – 10 A (setting within range to be confirmed during commissioning)</i>	<i>0.5 - 2.0 seconds (setting within range to be confirmed during commissioning)</i>
<i>Detection System Operating Bandwidth</i>	<i>47 Hz to 53 Hz</i>	

**Table 13: Ripple Detection System Parameter**

Levels of higher harmonics currents shall be demonstrated by design and tested during Delivery Testing using the envelope defined in SC 0018 00 00 SP, Specification – Rolling Stock Signalling Interface Requirements under various operating conditions especially across the OHW voltage range and under predicted failure modes. The interference curve within SC 0018 00 00 SP shall not be exceeded.

10.2.18.1 50 Hz Detection System Failure Detection

RFTA  
00106

The 50Hz line current detection system shall have a simple method of checking for correct operation by Maintenance Staff by operating the function test switch in the roof module.

10.2.18.2 50 Hz Detection System Settings

The 50Hz line ripple current detection system level and time period settings, shall be proposed by PPP Co for review and acceptance by RailCorp.

10.2.18.3 50 Hz Detection System Monitored

Triggering of the 50 Hz line ripple current detection system shall be logged by the TOS and reported to the Driver.

10.2.19 Carriage Separation

Where high voltage traction cables cross an intercar interface, protection shall be provided to safely cut off high voltage power in the event of Car separation.

10.2.20 Traction Subsystem Reset

The design shall provide means for the Driver to reset traction equipment that has tripped due to a Fault condition. First-level resets shall be performed by the Driver at the Driver’s Workstation, by moving the traction control to the off position, then re-applying power. Higher-level resets may be by other means initiated from the active Driver’s Workstation. RailCorp prefers that traction reset shall be automatic for two attempts and should reset not be possible on a third attempt the Driver shall be prompted to reset traction via the TOS screen. PPP Co shall agree details of the traction resetting with RailCorp.

10.2.21 Protection Signals

The traction Subsystem shall provide all protection signals used by the traction Subsystem to the TOS.

10.2.22 Wheel Slip Protection

The Set shall include wheel slip protection to maximise the available tractive effort under conditions of poor adhesion.

Performance testing verification of wheel slip control shall be undertaken by a combination of simulation and testing in combination with wheel slide braking performance tests using the same soluble oil in water mixture slip/slide solution sprayed onto the track as described in clause 10.4.2 – WSP Performance of this RailCorp Train Performance Specification.

Minimum performance parameters to be achieved for wheel slip control, with results and measurements adjusted to equate to a level grade, are as follows:

a) For a 12% wheel-to-rail adhesion a simulation of distance-based average acceleration shall ~~be~~ show the capability to achieve at least  $0.55\text{ms}^{-2}$  the value shown below from the completion of jerk-limited ramp-up of tractive effort up to 37 km/h; and

b) For a 9% wheel-to-rail adhesion a simulation of distance-based average acceleration shall ~~be~~ show the capability to achieve at least the value shown below  $0.42\text{ms}^{-2}$  from the completion of jerk-limited ramp-up of tractive effort up to 45 km/h.

Acceleration with Reduced Available Adhesion

<u>Assumed Available Adhesion</u>	<u>Acceleration to be Achieved</u>
12%	$0.85 \times 1.0 \text{ ms}^{-2} \times (12/(\text{adhesion per Motor Car @ } 1.0 \text{ ms}^{-2}))$
9%	$0.85 \times 1.0 \text{ ms}^{-2} \times (9/(\text{adhesion per Motor Car @ } 1.0 \text{ ms}^{-2}))$

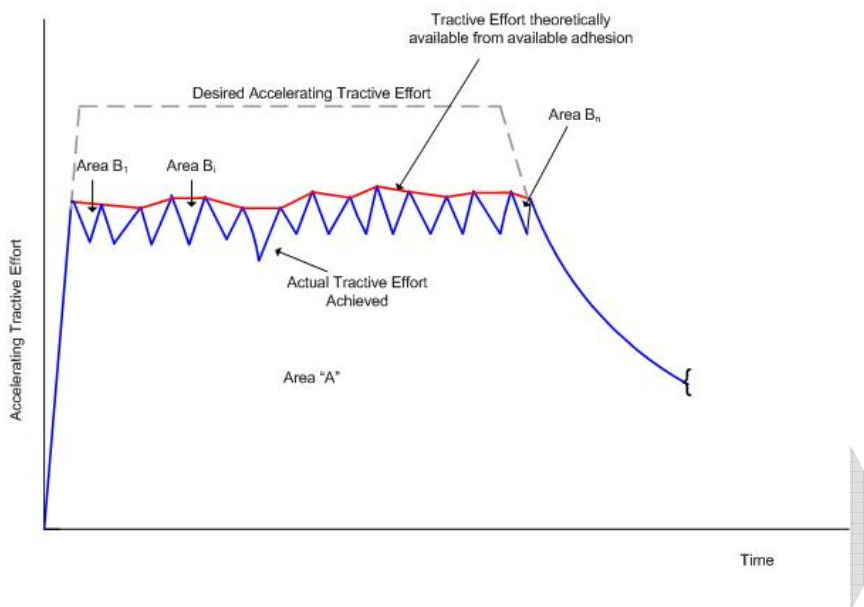
where “adhesion per Motor Car @ 1.0 ms<sup>-2</sup>” = tractive effort per Motor Car while achieving Set acceleration of 1.0 ms<sup>-2</sup> in the absence of wheel slip, divided by the weight (mass x g) per Motor Car as delivered, expressed as a percent.

c) For all conditions in which 9% or greater adhesion is available the efficiency of the wheel slip control, when tested under AW0 and AW3 conditions and measured in accordance with the sketch below, shall be at least 85%. For conditions in which adhesion less than 9% is measured, but is at least 6%, the wheel slip control shall continue to operate to make best endeavours to maximise performance but this may be at a degraded efficiency percentage.

RFTA  
00063  
RFTA  
00167

RFTA  
00063

**Acceleration on Slippery Rail**



**Efficiency of Wheel Spin Detection Correction System:**

$$\frac{Area\ A}{Area\ A + \sum_{i=1}^n Area\ B\ i} \times 100$$

10.2.23 Traction equipment efficiency

The traction equipment efficiency shall be as defined in Appendix Z (Traction equipment efficiency).

**10.3 Braking**

10.3.1 Brake Equipment

The brake Subsystem shall automatically compensate for the full range of friction material wear, such that the complete friction material is used without impairing the performance of the brake Subsystem.

The wear compensation shall be able to take up the full wear range within 3 brake applications.

10.3.2 Load Compensation

Load compensation for service and Automatic Brake (including Emergency Brake) shall be provided to maintain braking performance irrespective of load. Under conditions where the load compensation fails, the brake performance may default to the AW0 load value.

The load compensation Subsystem shall not cause changes in the braking effort due to track-induced suspension movements.

10.3.3 Safe Operating Pressure

All brake system fittings and connections shall be heavy duty and suitable for 1700 kPa continuous maximum operating pressure.

Other brake system components shall be capable of safe operation with a supply pressure of 1000 kPa with pressure regulators or relief valves employed to protect equipment that operates at lower pressures.

10.3.4 Trip and Isolating Cock Manual Positioning

Facilities for manual operation of the Trip Gear and SAI and terminal Brake Pipe cocks shall be provided without loss of performance.

10.3.5 Bogie Movement

The brake system shall accommodate the full range of movement of the bogie and its components without loss of performance. Operational movement of the bogie shall not cause deterioration to the brake system.

10.3.6 Braking Indication

The TOS shall be provided with indicators for the braking systems, including regenerative and Service Brake blending, showing whether all elements are fully operational or not. This information shall be shown to the Driver on demand only.

10.3.7 Master Controller Operation – Braking

Movement of the Master Controller in its brake control section by the Driver shall operate the Service Brake and Emergency Brake throughout the whole Set. The progressive movement of the Master Controller shall control the application and release of these brakes.

At the "off" position all brakes shall be released.

As the Master Controller is moved to demand increased brake effort, the brakes shall be progressively applied, initially using the Service Brake.

When the Master Controller is moved to its farthest position in the brake direction, the Emergency Brake shall be applied.

As the Master Controller is moved towards the "off" position, the brakes shall be progressively released.

To remove the key to deactivate the Cab, the Master Controller shall be in the full Service Brake or Emergency Brake position.

10.3.8 Service Brake

In the normal condition, the Service Brake shall decelerate the Set using the EP Brake and Electric Brakes.

10.3.9 Failure of the EP Brake - Shadowing

For all brake controller positions, Failure of the EP Brake control system shall cause an application of the Automatic Brake such that a similar braking effort is applied, without requiring any action by the Crew.

Only the following Failures shall result in a changeover to Automatic Brake:

- a) loss of battery supply to the leading Car brake system;
- b) discontinuity in the brake demand train-line wire; ~~and~~
- c) loss of communication between electronic brake control unit and EP Brake unit; and;
- d) any other Equipment Failure agreed with RailCorp.

RFTA 00067
RFTA 00067

A switch shall be provided, which permits the Driver to test and operate the Set using the Automatic Brake. Use of this switch shall be recorded in the Event Recorder and displayed whilst in use via the TOS to the Driver and Guard.

### 10.3.10 Electric Braking

Electric braking shall be provided as part of the normal Service Brake. The Electric Braking shall comprise regenerative and rheostatic braking.

Electric Braking effort shall be maximised with regenerative braking maximised with the following provisions:

- a) On dry track the Electric Braking on the motored axles shall be maximised and Friction Braking on motored and non-motored axles minimised;
- b) When low levels of WSP activity are detected on motored axles, the degree of brake load transfer between the motored and non-motored axles shall be reduced. This transfer shall be accomplished in accordance with the requirements of clause 10.1.3 (Deceleration) and clause 10.1.4 (Maximum Longitudinal Jerk) of this RailCorp Train Performance Specification; and
- c) When high levels of WSP activity are detected on motored axles under braking, the braking load transferred between motored and non-motored axles shall be nil.

#### 10.3.10.1 Electric Braking Abandonment

Once Electric Braking is abandoned during a brake application, it shall require the master controller to be moved to the release position before Electric Braking is able to be re-established.

### 10.3.11 Electric Brake Failure

If the Electric Brake fails, then Friction Braking shall make up 95% of the required braking effort within 1.2 seconds.

### 10.3.12 Brake Blending

RFTA  
00061 Blending of regenerative and non-regenerative braking shall be automatic, ~~smooth~~, continuous and reversible, and shall meet the maximum blending transition variation requirements in Table 12 EP Braking Type section 10.1.3 [as amended by RFTA00059] of this RailCorp Train Performance Specification.

### 10.3.13 Rheostatic Brake Rating

The rheostatic brake shall be continuously rated for all braking duty cycles.

### 10.3.14 Motor Cut-out

The Electric Brake shall remain functional on a Set when some of the traction packages are isolated.

### 10.3.15 Emergency Braking

When Emergency Braking is applied traction shall be disabled and any Electric Braking effort shall be reduced smoothly to zero.

#### 10.3.15.1 Emergency Brake Performance at Changeover

The deceleration of the Set shall not be reduced by more than 0.04 m/s<sup>2</sup> when changing from Service Braking to Emergency Braking at any speed.

#### 10.3.15.2 Emergency Brake

The Emergency Brake function shall cause a full application of the Friction Braking and shall act on all wheels. If the EP Brake is in use or power to the EP Brake is available, then the EP Brake shall remain fully applied during Emergency Braking.

The Emergency Brake shall be controlled by Brake Pipe pressure throughout all coupled Sets. The Emergency Brake shall be applied if the Brake Pipe pressure is vented and shall include wheel slip/slide operation.

The Emergency Brake shall be applied in the event of the Set passing a raised Train Stop by tripping of the trip cock venting the Brake Pipe to atmosphere.

---

In the event of a breakaway of one or more Cars the Emergency Brake shall be applied in all Cars (both sections) by venting of the Brake Pipe to atmosphere.

#### 10.3.16 Park Brake

All Cars shall be fitted with at least one Fail-safe Park Brake on each bogie.

The Park Brake system shall be able to hold an AW3 loaded Set on a maximum grade of 1 in 25 for an indefinite period.

Assuming a wheel-to-rail friction coefficient of at least 0.09, it shall be possible to move the Set in AW0 condition with the Park Brakes on, without skidding any wheels, and considering the worst case Tolerances of all the components that affect this condition.

The Park Brake shall be applied automatically in the event of Master Control Key removal.

##### 10.3.16.1 Park Brake Remote Application

The Park Brakes throughout the Set shall be able to be applied from any active or non-active Driver's Workstation.

##### 10.3.16.2 Park Brake Release

The Park Brakes throughout the Set shall be able to be released only from an active Driver's Workstation and only when the Brake Pipe pressure is above the control governor setting.

##### 10.3.16.3 Park Brake on Non-Cab Car

On a Car without a Cab the Park Brake shall be able to be locally applied and released from within a locked interior equipment cupboard and shall operate independent of Brake Pipe pressure.

##### 10.3.16.4 Park Brake Car Indication

A local Park Brake off-on status indication shall be provided in each Car adjacent to the Park Brake apply and release control showing the Park Brake status for both bogies. Coloured zones shall be used and the indicator clearly marked "Park Brake released" and "Park Brake applied" in the corresponding zone.

##### 10.3.16.5 Park Brake Manual Release Location

Each Park Brake shall be provided with a manual release, which shall be accessible and clearly identifiable from platform and track level. It is not acceptable for Crew to kneel on the platform to reach the manual release and a suitable tool to aid operation shall be included in the emergency equipment cupboard. If there are two Park Brake releases on a bogie they shall be adjacent to each other.

##### 10.3.16.6 Park Brake Indication

Remote indication of the status of all Park Brakes in the Set shall be provided on the Driver's Workstation covering "applied", "released", "isolated" and "change of state" and shall be clearly identified.

##### 10.3.16.7 Anti-compounding

Anti-compounding of the Park Brake and air brake forces shall ensure that any reduction of the air brake pressure during WSP activity or otherwise shall not result in a corresponding increase in brake force if both brake systems are applied.

## 10.4 Wheel Slide Protection

### 10.4.1 Wheel Slide Protection

A Wheel Slide Protection (WSP) system shall be provided for all forms of wheel-based braking except the Park Brake.

This shall reduce braking effort on locked Wheelsets to reduce Wheelset damage and minimise braking distances.

#### 10.4.2 WSP Performance

The Wheelslide Protection Systems for both the traction and the braking Subsystems shall be designed to control wheel-slide in order to maximise available adhesion whilst providing protection against wheel tread damage. The WSP system shall coordinate the operation of the traction and braking systems to ensure that one system shall not be controlled to increase traction or brake effort when the other is being controlled to do the opposite.

The design parameters for the Set shall be such that braking performance of the Set shall be maximised under poor rail conditions with indicative performance parameters being as follows:

- a) Overall distance-based average deceleration  $>0.9 \text{ ms}^{-2}$  for all braking modes under 12% adhesion conditions,  $>0.75 \text{ ms}^{-2}$  for all braking modes under 8% adhesion conditions; and
- b) Time to achieve an instantaneous deceleration rate in excess of  $0.70 \text{ ms}^{-2} < 4.0 \text{ sec}$ , under the adhesion conditions described in paragraph (a) above.

The performance of the Set shall be confirmed against these target values and in testing against a Tangara train under conditions as set out below:

- c) Eight-Car Set;
- d) AW0 loading condition;
- e) Water-spraying equipment fitted to spray oil/water solution on track ahead of each wheel of leading wheel-set of each Car.

RFTA  
00023

f) Testing to be carried out on dry track before using soluble oil/water solution or a slip/slide solution proposed by PPP Co and accepted by RailCorp and subsequently repeated on dry track before using other concentrations of soluble oil/water solution or a slip/slide solution proposed by PPP Co and accepted by RailCorp. The soluble oil used shall be "Shell Dromus BL Soluble Cutting Oil";

g) Volumetric flow rate of the water-spraying equipment shall be 1.2 l/min ( $\pm 10\%$ ) per nozzle; and

h) Testing is to be conducted (minimum of 5 stops for each combination) at the following modes and speeds ( $\pm 5 \text{ km/h}$ ):

- i. Trip Stop Emergency braking at 70 km/h and 100 km/h;
- ii. Maximum EP (only) braking at 70 km/h and 100 km/h;
- iii. Maximum EP and Electric Braking at 70 km/h and 100 km/h; and

RFTA  
00023

iv. Trip Stop Emergency Braking Driver's brake valve application of the emergency brake at 70 km/h and 100 km/h.

The performance of the traction system wheel-slide control of Electric Braking, under the test conditions of EP Braking and Electric Braking, shall be equivalent (within 5%) to that achieved by the air brake WSP system under EP Brake only test conditions. The values used for setting the control limits of the WSP equipment shall be reviewed with and accepted by RailCorp in conjunction with testing on the train to optimise these values.

#### 10.4.3 WSP Status

The status of the WSP shall be monitored by the TOS.

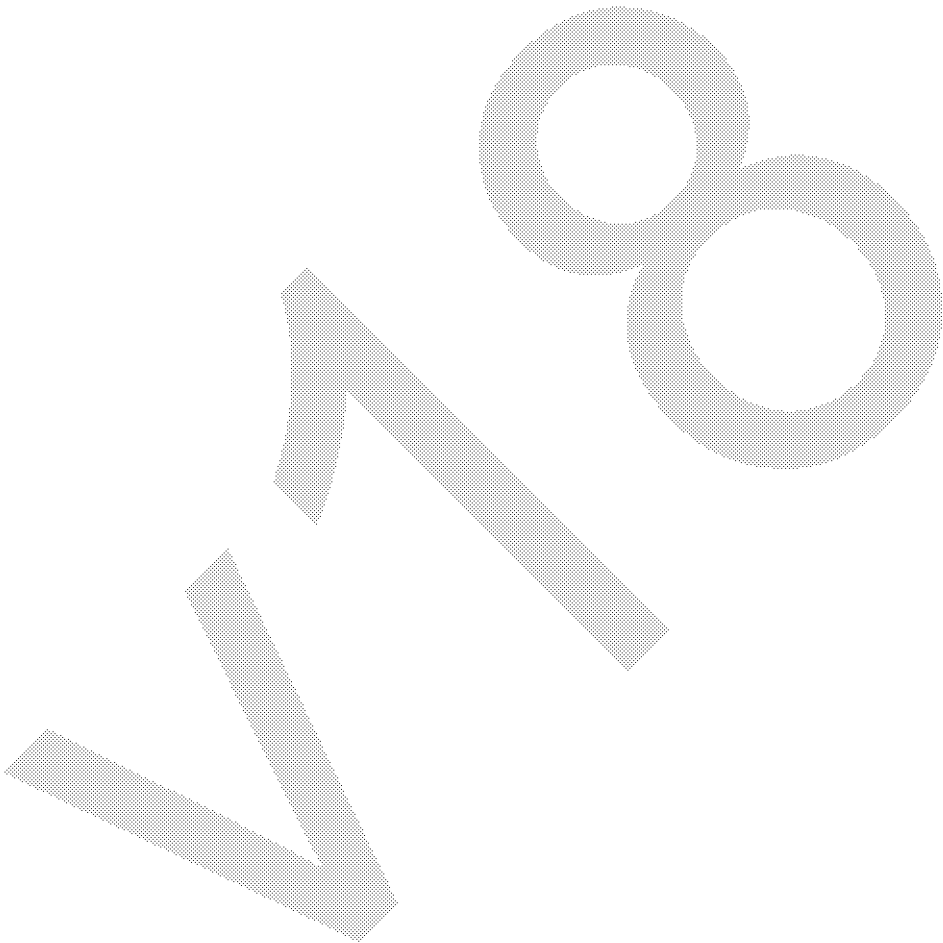
#### 10.4.4 WSP Circuit Breaker

RFTA  
00074

~~Not Used The WSP Circuit Breaker shall be inaccessible to Crew.~~

10.4.5 Wheel to Rail Adhesion

The assumed value for wheel to rail adhesion shall be declared for wheel-slip and wheel-slide performance calculations for acceptance by RailCorp.





## 11 Communication System

### 11.1 General Requirements

The Set shall provide:

- (a) audio communications between Crew (Crew Intercom);
- (b) audio communications between Passengers in the Vestibule area/designated Wheelchair Spaces and Crew (Passenger Emergency Intercom);
- (c) audio communications between Crew and Passengers throughout all Passenger areas (internal Public Address);
- (d) audio communications between Crew and Passengers outside the Set standing on platforms (external Public Address);
- (e) automated Digital Voice Annunciation (DVA) to Passengers, both internal and external;
- (f) augmented hearing for internal DVA/manual announcements;
- (g) automated audio and visual door movement warnings to Passengers;
- (h) bell communications between the Crew;
- (i) a Door Warning Device (DWD);
- (j) external horn, operated by the Crew and audible to persons outside the Set;
- (k) radio communications between the Set and external systems, both voice and data;
- (l) signage throughout the Set including fixed and electronic destination indicators;
- (m) video surveillance of all Passenger areas throughout the Set; and
- (n) capability to use communications systems as part of future train control and management systems, including, but not limited to communication based train control systems and Automatic Train Protection systems.

#### 11.1.1 Communications Equipment Control

Control of the communications equipment shall be independent of other Set systems with the exception of the DVA and the electronic signage, which shall be controlled from the TOS screen, and the Door Warning Device.

Other than those required by the Crew and Passengers to operate the equipment, no switches or controls shall be externally accessible.

The equipment and systems shall permit concurrent use by both the Driver and Guard e.g. Train Radio and Crew Intercom.

Each handset shall be integrated and provide the ability for the Crew to use all communications subsystems using a single handset with a functionality equivalent to the existing MetroNet radio handset. The handset position of any communications equipment shall be reviewed to ensure that use of the handset does not conflict with the use of other controls. Trailing cords shall not interfere with other equipment.

Set-wide communications shall be consistent across all Cars and any inconsistencies shall be identified and reported to the Guard.

#### 11.1.2 Communications Equipment Protection

Any equipment with a conductive surface or controls that may be contacted by Passengers or Crew shall include an equipotential bond to the Set frame to eliminate any risk of shock.

All equipment provided for the communications system shall generally be protected against all transient conditions that may be applied to the input, output and power supply circuits. Circuits on the Set capable of

producing transients shall have energy adsorbing devices fitted to prevent the propagation of transients into other Set systems.

Equipment shall not be adversely affected by continuous overload, short circuit or open circuit output.

Amplifiers shall not be adversely affected if more than one amplifier is output to the same line at the same time.

There shall be no adverse effect if the PA, Intercom or other equipment or systems in the same Crew Cab or in separate Cabs are operated at the same time.

There shall be no adverse effect if the Set control voltage is connected across any amplifier input or output.

Overload protection shall be provided by a device that automatically resets on removal of power or by self restoring protection devices.

In the event of a line voltage or Main Power Supply Failure, the communication system shall continue to operate normally.

#### 11.1.3 Communications Equipment Performance

The signal to noise ratio for amplifiers shall be 70 dB or better, when any controls are adjusted for maximum output.

There shall be no discernible feedback, cross-talk, interference or noise produced by equipment or systems including amplifiers, or other components or switching functions either electrical or mechanical.

When equipment is in the quiescent state no discernible noise shall emanate from it either by virtue of an output to speakers, sounders or earpieces or by virtue of noise transmission through components and housings or any other means.

The total harmonic distortion shall not be discernible and for audio equipment the power and output amplifiers shall not exceed 0.4% at the rated output.

Amplifier design shall be Class D, commonly referred to as “digital amplifiers” to reduce power demand, heat dissipation requirements and packaging size.

RFTA  
00299

Indicators for power, output and status shall be provided on the front panel of the equipment shall be clearly identified. PPP Co shall provide a list of the indicators provided for each of the communications equipment identified in clause 11.1(a) to (n) of this specification.

Power consumption of the communications equipment and systems shall be minimised in all modes of operation.

All the communication equipment shall communicate clear and intelligible messages to all Passengers and Crew as selected.

#### 11.1.4 Equipment Self Test

The communications equipment shall be self-monitoring and shall include self-test capabilities for all equipment in each Car. The self-test shall be performed as part of Train Preparation and shall be reported as part of the status report.

The Equipment Failures shall be monitored by TOS, reported to the Driver and logged on the Event Recorder as required elsewhere in this RailCorp Train Performance Specification.

#### 11.1.5 Equipment Redundancy

Where there is duplicate communications equipment on the Set this may be used to provide back-up to enable train services to be maintained in the event of Equipment Failure.

### 11.2 Crew Communication Interface

As a minimum requirement the Crew's communication system shall include:-

- (a) handset;

- (b) PA push button;
- (c) intercom push button; and
- (d) Passenger Emergency Intercom direct reply push button.

The controls shall be ergonomically designed and selected and extended operation of the push buttons shall not cause operator fatigue. Push buttons shall be coloured and marked in compliance with Appendix R – Control Switch Panels.

The number and location of handsets to be provided within the Crew Cabs will be determined during Mock-up consultation. It is anticipated that handsets will be required for the Driver and also for the Guard at his or her seat and also in locations that can be easily reached when operating the door controls.

### 11.3 Timetable Changes

#### 11.3.1 Revised Timetable

RailCorp updates the Timetable a number of times per year and is aiming to implement a "Daily Working Timetable". The Set shall have the facility to accept and store new Timetable and DVA data until a programmable date and time occurs. At the predefined date and time the DVA and other systems that use this data shall changeover from the "old" data to the "new" data. If an affected Set is currently on a run then the changeover shall be deferred until completion or cancellation of that run. Simple methods shall be provided to:

- (a) Operate and program the equipment;
- (b) Make changes in response to Timetable changes;
- (c) Generate or record announcements for the DVA;
- (d) Upload "new" data (including announcements) to the Set by removable data medium; and
- (e) Delete data from the Set

The time and resources required to perform these functions shall be kept to a minimum and shall take into consideration the need to reprogram the fleet quickly due to Timetable changes. All Cars in a formation shall be updated from one action. E.g. in an eight-Car set only one download shall be necessary, with the Set systems propagating the updated data to each sub equipment in the formation.

It shall be possible to update the entire fleet within a 24 hour period starting upon the receipt by PPP Co of validated timetable data.

The Set shall expose, via the RailCorp Data Link, services such as, the transactions listed in Table 14 below:

Transaction	Description	From	To	Frequency of Transaction
Update run data to the Set	Updates the current run data on a Set with any changes remotely via the RailCorp Data Link	RailCorp	PPP Set	Frequently (>3 per day)
Update Timetable data to the Set	Updates the current Timetable data on a Set with any changes remotely via the RailCorp Data Link	RailCorp	PPP Set	Monthly

**Table 14: Timetable Transactions**

11.3.2 Special Train Notices (STN)

It shall be possible for the Driver or Guard to input a change related to an STN or other authorised communication and appropriate audio and visual information shall then be provided to Passengers.

**11.4 Public Address and Intercommunication System**

The Intercom equipment shall operate independently of the operation of the Public Address equipment except that user interfaces may be common. The Intercom equipment shall operate separately and independently from the DVA and Door Warning Device.

The Intercom communications shall not be audible on the PA. The PA communications shall not be audible on the intercom, except that a minimal and non-interfering low level of acoustic audio coupling from Passenger area speakers to Crew and PEI can be allowed.

Indicators shall be provided on or adjacent to the PA and Intercom controls to provide visual feedback of actual PA and intercom output. The equipment shall provide visual indication to the Crew or Passenger initiating the call that the call is audible in the Passenger area(s) or Crew Cab, as appropriate.

11.4.1 Intercom Operation

RFTA  
00172

The Set shall provide Crew Intercom (CI) equipment permitting the Crew to communicate with each other (between the Crew Cabs) using a duplex system, and Passenger Emergency Intercom (PEI), permitting the Passengers to communicate with Crew using a half duplex or full duplex system. When connected to a PEI call, the Crew shall be able to use the Push to Talk button on the handset to speak to the Passenger and release the Push to Talk button to mute the Crew's voice. For a half duplex PEI, the control of speech direction shall be from the Crew side equipment. For a full duplex PEI system with the Push to Talk button depressed, the speaker in the active PEI unit shall continue to emit the Crew's speech irrespective of whether the Passenger is silent or talking and the Crew shall not detect any feedback through the active PEI unit.

The Intercom shall provide the capacity to handle multiple calls from Passengers and Crew.

11.4.2 Crew Intercom Operation

The CI shall provide high quality, reliable communication between the Crew and in conjunction with the PEI for emergency communication with Passengers.

The CI amplifiers shall be capable of supporting a 25% overload or provide for 25% additional capacity without any adverse effect on performance.

Passenger Emergency Intercom input priority order shall be:

- (a) Guard or Driver Crew Intercom;
- (b) Guard or Driver reply to PEI; or
- (c) Passenger calling from PEI.

The Intercom shall only be available in an Active Crew Cab. The Driver and Guard shall have the same facilities and access. Both the Driver and Guard shall be able to access and operate the system at the same time.

11.4.3 Incoming Calls

Calls shall be queued and addressed in turn as the call at the head of the queue is cleared. The queue status shall be displayed to the Crew. The Intercom shall provide a visual and audible annunciation to the Crew of each new call received, and shall indicate whether the caller is a Passenger or Crew. For calls from Passengers, the Intercom shall display the location of each caller. A separate tone shall be triggered in the event of an Emergency Door Release device being operated and the local PEI to that Emergency Door shall be entered into the queue.

If there is no other call in progress, a Crew call shall be connected to the Crew immediately.

When there is already a call in progress, the call shall not interrupt the current call, but shall visually and audibly alert the Crew of the call waiting. Operation of the PEI system shall not interrupt or disable other communication systems such as the Train Radio. A Passenger-to-Crew call shall initially only be heard in the active Guard’s Workstation.

The Crew member taking the PEI call shall be able to hold that call and operate the Intercom to the other Crew member. On completing that CI call, communication shall then be re-established with the original PEI call.

A Crew-to-Crew call shall be heard throughout all Active Crew Cabs, and shall be inaudible to Passengers.

11.4.4 Passenger Emergency Intercom Call Clearance

The Intercom shall maintain a connection until the Crew presses the "CLEAR CALL" button located at the microphone/control panel, or all Crew Cabs are deactivated, or the calling PEI is deactivated.

11.4.5 PEI Operation

RFTA	Passengers will initiate a call to the Crew by operating a push-button on a RailCorp standard PEI interface panel, <del>which</del> . <u>Standard PEIs shall comply with the drawing as attached in Appendix P – PEI Signage.</u>
RFTA 00300	<u>Alternative designs incorporating the same functionality and ergonomically suitable for use by Passengers in wheelchairs may be fitted at wheelchair spaces subject to approval by RailCorp.</u>
RFTA 0022	<p>During all normal running conditions a Passenger, within 250 mm of the microphone, shall be heard clearly by the Crew, <u>or RailCorp staff member receiving an escalated PEI call</u>, when the PEI call is established.</p> <p><u>The PEI shall have no internal adjustments. Tones and levels shall be determined by trial in traffic and then fixed in the units during manufacture or shall be self-adjusting against a system standard.</u></p> <p><u>All time limits shall be adjustable by PPP Co at no cost to RailCorp on request.</u></p> <p>During all normal running conditions any reply from the Guard, within 250 mm of the microphone, to a Passenger shall be clearly heard at a distance of at least one (1) metre from the PEI.</p> <p><del>The PEI shall have no internal adjustments. Tones and levels shall be determined by trial in traffic and then fixed in the units during manufacture or shall be self-adjusting against a system standard.</del></p> <p><del>All time limits shall be adjustable by PPP Co at no cost to RailCorp on request.</del></p>
	<p>The Intercom shall maintain a connection until the Crew presses the "CLEAR CALL" button located at the microphone/control panel, or all Crew Cabs are deactivated, or the calling PEI is deactivated.</p> <p>If a PEI call remains unanswered by the Driver or Guard after 30 seconds then an additional visual/audio alert will warn the Crew that the call will escalate in 60 seconds.</p> <p>If, following a further 60 seconds neither the Guard nor the Driver respond, and if the Train Radio, Intercom or PA on the Set are not being used (i.e. no change of state), then the PEI unit shall be connected automatically to the Train Radio system to enable the PEI call to be answered directly by a RailCorp staff member not on board the Set.</p>

All time limits shall be adjustable by PPP Co at no cost to RailCorp on request.

11.4.6 PEI Appearance

The PEI shall be generally consistent with the standard drawing as shown in Appendix P – PEI Signage.

The PEI shall incorporate Braille versions of the signage and tactile clues as shown in Appendix P – PEI Signage, to assist visually impaired persons.

11.4.7 PEI Operational in Isolated (Nightsafe) Cars

The PEI shall remain operational in all isolated Cars. The PEI button shall be illuminated.

#### 11.4.8 PEI information logged by Event Recorder

For each operation of the PEI (Press to Call button) and Crew or escalated response (PEI reply button) the Event Recorder shall record:-

- (a) the date and time of each PEI call and Crew or escalated response;
- (b) the calling PEI location (Car number and end); and
- (c) the queue status at the time of the PEI call.

#### 11.4.9 PEI Abnormal and Failure Conditions

If a PEI button on any PEI is held in for more than 30 seconds continuously then that PEI shall report this to the TOS, but does not remove the call from the queue, and the unit shall be disabled until the button is released or the Crew responds, resets or isolates that PEI. The change of status of the PEI shall be recorded.

Concurrent operation of the same function shall not be allowed where such operation would result in unintelligible communications, in which case the first user to select that function would temporarily lock out any subsequent user until such time as the first user releases that function. Any lock out shall be advised to any subsequent user during the period they are locked out.

The PEI shall include an indicator LED that is illuminated when the unit is operational.

The incorrect deactivation or Failure, including Failure to respond at start-up, of any PEI shall be reported and recorded by the TOS.

#### 11.4.10 PEI Design and Location

Each Car shall have a minimum of two PEIs. One PEI shall be located in each door Vestibule adjacent to the Emergency Doors with further PEIs located adjacent to and in reach of each wheelchair-bound person utilising a Wheelchair Space. The final PEI locations shall be agreed during the development of the Mock-up, taking ergonomic principles into account.

The PEI button shall be located below the speaker between 900 mm and 1100 mm Above Floor Level (AFL) with preference for 1000 mm AFL. If a secondary push to call button is required it shall be clearly marked as to its intended function.

The PEI buttons shall be red in colour, at least 35 mm in diameter and simple for persons with disabilities to identify and operate. The PEI buttons shall not protrude. The PEI buttons shall be concave by approximately 3 mm at the button centre. The background surface shall be colour contrasted to the controls and text.

Status indicators shall be provided to inform users of the PEI operation. Parameters displayed shall clearly indicate the operation of the PEI (including POWER, TALK/PTC and BUSY/OUTPUT). Visual and audible feedback shall be provided to the Passenger calling that the unit is operating (e.g. brief click/beep/tones on pressing the push-button and on operation of the TALK/PTC/BUSY/OUTPUT indications).

RFTA  
00073

Local Circuit Breakers shall be provided in a secure area for the PEIs at each Vestibule. Circuit Breaker and wiring design shall ensure that tripping of a single PEI circuit does not affect the operation of the other PEI in the same vestibule.

The PEI equipment including the speaker and microphone shall be protected from the insertion of needles or other objects. The PEI speaker and microphone shall be protected from or unaffected by dust, moisture, aerosol spray can paints, cleaning and cleaning agents. The PEI shall have suitable drain holes to prevent accumulation of liquids. The PEI shall seal against the wall and prevent the ingress of dust and liquids to the wall cavity.

#### 11.4.11 PEI Car Numbers

A Car numberplate shall be securely affixed approximately 100mm above the PEI unit. The PEI shall incorporate Braille and tactile signage above the PEI plate and be located between 1200 mm and 1600 mm

AFL. The Car numbers shall be Vandal, Graffiti and Graffiti cleaner resistant. The numbers shall be immediately obvious and clearly legible to a person using the PEI unit.

#### 11.4.12 Interfaces

On operation of an internal EDR the local PEI shall initiate a call to the Crew to enable them to communicate with the Passenger operating the EDR.

On operation of a PEI the CCTV system shall be controlled to show an image of the PEI to the Guard and Driver (although the display to the Driver may be suppressed if required by RailCorp).

### 11.5 Public Address System

RFTA  
00301

The Public Address (PA) system shall allow Crew to make high quality audio announcements internal and/or external to the Set from an active Crew Cab. Additionally, the PA system shall allow a RailCorp staff member not on board the Set to make remote PA announcements in the event that the Driver and the Guard are not able to do so.

#### 11.5.1 PA Audibility

The Crew shall be able to select whether the PA is heard:

- (a) internal to the Set;
- (b) external to the Set (either side or both sides); and/or
- (c) internal and external to the Set (internal plus either side external or internal plus both sides external).

The PA audibility shall meet the following criteria at all points within the Passenger areas of the Set.

- (d) *Standard operating Level (SOL)*: A sound pressure level LZeq of 75 dB (LZeq is the Leq with linear frequency weighting). This level shall be measured with a sound level meter (SLM) set to 'fast', with band-limited pink noise (200 Hz to 5 kHz) produced by a loudspeaker at a level LZeq of 87 dB (lin) at the microphone capsule;
- (e) *Max SPL capability*: A sound pressure level LZeq of 85 dB(lin). A crest factor of at least 10 dB available above this level shall be available to accommodate the normal peaks of speech. The LZeq level shall be measured with the SLM set to 'fast' with pink noise band limited (200 Hz to 5 kHz) fed to system. The LZpeak level shall be measured with a peak responding meter, and the crest factor determined as the difference between LZpeak and LZeq measurements;
- (f) *Consistency of overall sound level*: The overall Leq shall lie within a  $\pm 3$  dB range of the SOL for 95% of Passenger areas including aisles, with the carriage unoccupied. The Leq level shall be measured with SLM set to 'fast', with pink noise band limited 250 Hz to 4 kHz fed to system;
- (g) *Basic Frequency response*: 125 Hz to 8 kHz  $\pm 3$  dB, 250 Hz to 4 kHz  $\pm 2$  dB, for 95% of seats including aisles, carriage unoccupied. This shall be measured with the carriage unoccupied using pink noise integrated into octave bands; and
- (h) *Frequency response anomalies*: Any peak in the average frequency response that is wider than 1/10 octave shall be no more than +6dB above the average level of the spectrum, when the responses are averaged over 10 measurement positions. This shall be measured with a spectrum analyser capable of narrow band resolution with noise or swept sine input signal. The averaging process shall be based only on the relative frequency responses between the 10 locations, and shall not include the overall level differences between locations).

#### 11.5.2 Crew Presses "INTERNAL PA"

When the Crew presses a button labelled "INTERNAL PA", the Crew shall be connected to the internal PA. If there is a current DVA announcement in progress, the DVA announcement shall be interrupted. There shall be a provision to restart the DVA message if required by the Crew on completion of the PA announcement.

11.5.3 DVA

The DVA shall be connected via the internal PA when there is no current Crew announcement in progress and a DVA announcement has been triggered.

A 2 seconds pause shall separate each DVA announcement from any preceding Crew announcement.

11.5.4 PA Inputs and Priority Order

The priority order for the PA system shall be as follows:

- (a) Guard or Driver PA operation (or remote operation if the Driver and Guard are incapacitated) (equal);
- (b) DVA input to PA system; and
- (c) Spare line level input.

The Driver and Guard shall be able to select whether or not PA and DVA (internal and external) messages are announced in the Driver- or Guard-occupied Crew Cabs. The default setting shall be for PA and DVA (internal and external) messages to be audible in the Driver- or Guard-occupied Crew Cabs.

Both Crew shall have volume control in their Cabs. The minimum volume level shall be agreed in final commissioning or, if not agreed, determined by RailCorp's Representative. The control shall be arranged so that when a Cab is made active the volume reverts to the default level irrespective of its setting when the Cab was last shut down.

11.5.5 External PA

When the Crew presses a switch labelled "EXTERNAL PA" in any Crew Cab, the Crew shall be able to make announcements outside the Set. The external PA shall default to operate only on the side that the Passenger side doors are open/released. The Crew shall be able to select to make external PA announcements on either or both sides of the Set independent of the door status. The selection button shall require press to talk and shall not latch.

11.5.6 PA modelling

An electro-acoustic virtual model of the carriage shall be produced to ascertain that the design solution is compliant with this RailCorp Train Performance Specification. The EASE computer modelling package will be acceptable to RailCorp, although others may be suitable and may be used by agreement with RailCorp.

A wire frame of the carriage shall be built, and the proposed loudspeaker configuration entered. The resultant 'direct field' at a number of frequencies shall be plotted on the Passenger areas to indicate the consistency of sound levels and the frequency responses.

RFTA  
00366

Alternatively, the performance of the PA shall be demonstrated by physical measurement in a mock-up of the carriage or in a similar equivalent train carriage.

The following heights Above Floor Level shall be used to measure the sound levels: Sitting Passengers, 1.2m; Standing Passengers, 1.6m.

11.5.7 PA Test Mode

The PA shall have a test mode facility so that either the Driver or the Guard may set up an audible warning that will continue until cancelled to enable either Crewmember to walk through the Set and confirm that the PA is operational. Either Crewmember shall be able to cancel the test mode from any Active Crew Cab.

11.5.8 Assisted listening

RFTA  
00285

The internal PA system shall include assisted listening technology (hearing loops) to augment announcements (automatic and manual) for the hearing impaired. Coverage shall extend to upper and lower Saloons and shall be provided on the single deck level of the Passenger area on all Cars. A minimum of 10% of all seating areas shall be covered. The areas covered shall be consistent throughout the Set. The hearing loop signal over the stated coverage area shall be free of interference from other trainborne equipment have a signal to noise ratio greater than or equal to 15dB when measured with a bandwidth



ranging from 100Hz – 5kHz at 1.2m above the floor level with the test loop in the vertical plane. The signal shall be defined as the long-term (rms) linear speech level.

## 11.6 Bell System

### 11.6.1 Overview

A bell system shall be provided to permit the Crew to communicate throughout the Set using Morse or other types of codes.

The bell shall operate in all modes of the Set where Crew or maintenance personnel may be present irrespective of the status of the overhead or auxiliary supply.

The bell shall be operated by a momentary action push-button.

### 11.6.2 Control

RFTA  
00071

It shall be possible to send a bell signal from and a bell signal shall be received in all Crew Cabs irrespective of whether they are active or not. A Driver's station bell command can only be given provided that an active Driver sign-on is present somewhere on the Set. A Guard's station bell command can only be given if that station has an active guard sign-on and an active Driver sign-on is present somewhere on the Set. A bell signal shall be received in all Crew Cabs irrespective of whether they are active or not.

Sounding of the bell signal shall commence immediately the Driver's or Guard's push-button is operated and cease immediately the Driver's or Guard's push-button is released, provided that the bell has sounded for a minimum time adjustable in the range of 98 – 108 ms.

The bell system shall be ergonomically designed for simplicity, ease of operation and avoidance of fatigue.

### 11.6.3 Discrete System

The bell shall be an independent hard wired system, shall not interfere with any system or equipment and shall not be affected by any system or equipment.

### 11.6.4 Sound Differentiation

The sound of the bell may be produced by an actual bell, or synthesised or played from a recording.

The bell shall sound like the bells fitted to the majority of the CityRail Fleet

RFTA  
00072

The bell shall not sound harsh or shrill. PPP Co shall submit a working sample of the proposed bell or otherwise demonstrate the tonality of the bell to enable RailCorp to evaluate the sound of the bell.

The bell shall be clearly distinguishable from any other device on the Set.

The bell shall be clearly heard by the Crew in all normal operating conditions.

The loudness of the bell shall be at least 6 dB(A) above the sound level in the Crew Cab but not greater than 85 dB(A). It shall not be so loud as to cause discomfort or hearing impairment.

### 11.6.5 Tampering

The bell shall be mounted to prevent access of unauthorised personnel.

## 11.7 Door Warning Device (DWD)

PPP Co shall provide to each Set a Door Warning Device (DWD) which shall provide door warning closing messages and door movement warning cues integrated with the door control system and shall operate on door opening and closing.

At the initiation of the door closing cycle a door closing intermittent alert tone shall commence. This shall only be heard in the vicinity of the doors, i.e. it shall not be distributed by the Car speakers, and shall cease when the doors have closed and locked. The tone shall have a duty cycle, frequency component and volume level such that it cannot be misinterpreted as any other warning and does not cause acoustic

<p>RFTA 00308</p>	<p>annoyance to persons standing in the Vestibule area. A tone consistent with that used on recent CityRail rolling stock shall be adopted, with tones <u>nominally centred at a frequency of 2900 Hz +/- 500 Hz</u> <del>in the range 800 Hz—2000 to be used.</del></p>
	<p>A separate control shall be available at each Crew door control station to generate an announcement such as “Please stand clear, train is due to depart”. The announcement shall be readily re-programmable and shall be heard on the Vestibule and external speakers on the same side of the Set as the door controls in use.</p> <p>Additional visual cues for door movement shall commence upon opening or closing the door. The visual cue shall be a white light located to be visible from the inside and the outside of the Set and shall be off when in the closed position. The light shall differentiate between doors moving / doors open.</p> <p><b>11.8 Speakers</b></p> <p>11.8.1 Speakers in Passenger Areas</p> <p>Speakers shall be provided in Passenger areas for clear communication to the Passengers or Crew from the Public Address, Digital Voice Annunciator, Intercom and like systems.</p> <p>Speakers shall be concealed from Passengers. The speakers shall be protected from Vandalism, dust, moisture and insects.</p> <p>Speakers will generally operate intermittently but shall be capable of continuous operation. The speaker assembly shall be suitable for high quality voice announcements and background music.</p> <p>The loudness of announcements over the speakers in the Passenger areas shall be evenly distributed with a maximum variation of 4 dB at a height of 1.2 m above the floor and shall not be such as to cause discomfort or hearing impairment.</p> <p>The magnetic field strength produced by all hearing loops shall meet the requirements listed below over 90% of the stated coverage area at a height of 1.2 m above the floor.</p>
<p>RFTA 00286</p>	<p><del>When driven with a speech signal, the average long-term field strength at any point shall be of 0.1 A/m +/- 3dB.</del></p> <p><u>The value for the average long-term field strength in the stated coverage areas within the Cars, when driven with a speech signal, shall be 0.1 A/m +/-3dB, when measured:</u></p> <ul style="list-style-type: none"> <li><u>(a) in the vertical plane</u></li> <li><u>(b) above the centre point of the seat base</u></li> <li><u>(c) 1.2 metres above the finished floor level</u></li> <li><u>(d) using a true rms meter with 0.125 second averaging time.</u></li> </ul> <p><del>The variation of field strength at 400Hz over all seating areas shall be within +/- 3dB. The frequency response of the magnetic field shall be 100 Hz to 5 kHz ±1 dB.</del></p> <p><u>The average measured frequency response of the magnetic field within the range from 100 Hz to 5 kHz shall not differ by more than ±1 dB from the value at 1 kHz, measured above the centre point of the seat base at 1.2 metres height from finished floor level, with the test loop in the vertical plane.</u></p> <p><u>The value for magnetic field strength in the stated coverage areas within the Cars may be increased providing it does not exceed +5 dB re 1 A/m when measured:</u></p> <ul style="list-style-type: none"> <li><u>(a) using a 1 kHz sine wave;</u></li> <li><u>(b) in the vertical plane;</u></li> <li><u>(c) above the centre point of the seat base;</u></li> </ul>
<p>RFTA 00286</p>	<ul style="list-style-type: none"> <li><u>(d) 1.2 m above finished floor level;</u></li> <li><u>(e) using a true r.m.s. meter with 0.125 s averaging time.</u></li> </ul>

The undistorted maximum RMS capability of 0.4 A/m shall be provided whilst maintaining the stated frequency response.

Appropriate signage complying with Australian Standards AS1428.1 and AS1428.2 indicating the presence of a hearing assistance loop shall be installed in suitable locations in each Car.

#### 11.8.2 Speakers in Crew Areas

Speaker assemblies shall be provided in the Crew Cabs to provide clear communication in all normal-operating conditions from the PA, DVA, Train Radio, Intercom and like systems.

The loudness of the speaker output in the Crew areas shall be evenly distributed at a height of 1.2 m and shall not be such as to cause discomfort or hearing impairment.

A separate speaker shall be provided for the Train Radio.

#### 11.8.3 External Speakers

External Public Address Speakers shall be fitted near the Passenger bodyside doors on both sides of all Cars.

The speaker assembly shall be suitable for high quality PA voice announcements.

The loudness of announcements on platforms at a height of 1.5 m above platform surface and at 3 m from the side of the carriage shall be at least 9 dB above the normal ambient noise level. It shall be at least 75 dB(A) at a location of 3 m perpendicular to the Car body side and shall not vary by more than 6 dB between speaker locations along the Car.

The loudness of announcements over the external speakers shall be such as to not cause discomfort or hearing impairment to Passengers, intending Passengers or Crew.

The appearance and location of the external speaker assemblies shall be consistent throughout the fleet.

The design of the external speaker assembly and housing shall preclude the ingress of dust or moisture to the Car body even if the speaker is missing.

### 11.9 External Horn

RFTA  
00230

#### 11.9.1 Town and Country Horns

The Set shall be equipped with a town horn and a country horn. Controls shall be provided in close proximity to the Driver permitting the Driver to operate either horn individually or both horns simultaneously. The fundamental frequency of the country horn shall be 390 Hz +/- 25 Hz and the fundamental frequency of the town horn shall be 290 Hz +/- 25 Hz.

The horn shall be designed such that the Driver cannot bleed air quietly through it. Any Driver input to the horn control shall cause an immediate sounding of the horn for 250 ms or as long as the control is activated, whichever is the longer. All and any action of the horn shall be recorded in the Event Recorder along with the detail of which horn position was selected.

RFTA  
00244

The sound levels of the town horn and the country horn shall comply with the requirements of RSU 650 [8] for “low noise” and “high noise” horns respectively.

The sound level of the town horn and country horn as measured inside the associated Driver’s Cab shall not exceed 92 dB(A).

The operation of the primary horn control (located near the Vigilance Control push button to the right of the Driver) shall be as follows:

- (a) Forward – town horn;
- (b) Backward – country horn; and
- (c) Sideward – Both horns.

The operation of the secondary horn control (located on the Driver's switch panel to the left of the Driver) shall be as follows:

- (d) Up – town horn;
- (e) Down – country horn; and
- (f) Sideward – Both horns.

**11.9.2 Yard Horn**

RFTA  
00230

The Set shall be equipped with a yard horn.

The yard horn control shall be a separate control and shall be provided in close proximity to the Driver so that it can be operated whilst sitting or standing in the Driver's position. When activated, the yard horn control will sound the horn in the direction of travel for a period of time that shall be adjustable, on demand by RailCorp. The time period shall initially be set to 2 seconds and shall be adjustable between 2 and 30 seconds.

RFTA  
00230

The yard horn sound level shall be as detailed in the table below.

	<u>LA1 (60 seconds)</u> <u>7m,90deg from</u> <u>front of train</u>	<u>LAeq(15minutes)</u> <u>7m, 90deg from</u> <u>front of train</u>	<u>LAmix</u> <u>60m, 0deg from</u> <u>front of train</u>
<u>"Broadband Alarm"</u>	<u>79-81dBA</u>	<u>54-56dBA</u>	<u>64-66dBA</u>

The yard horn noise level shall be assessed against ISO 7731:2003 Ergonomics- Danger signals for public and work areas- Auditory danger signals. PPP Co shall submit a working sample of the proposed yard horn or otherwise demonstrate the tonality of the horn to enable RailCorp to evaluate the sound of the horn. An indicative and acceptable sound is achieved by the BBS Tek BBS-97 Broadband Alarm.

Activation of the yard horn control shall simultaneously activate flashing of the fog lights. This flashing shall continue for a time period that shall be adjustable, on demand by RailCorp. The time period shall initially be set to 5 seconds, and shall be adjustable between 5 and 30 seconds.

The yard horn shall only operate from an active Drivers Cab.

The yard horn operation shall be recorded on the Event Recorder as a unique signal.

**11.10 Closed Circuit Television (CCTV)**

**11.10.1 Overview**

The Set shall be provided with an on-board digital Closed Circuit Television System (CCTV) based around current technology components. The CCTV system shall provide full coverage of all Passenger areas, the interface between the Passenger bodyside doors and platforms, and the view ahead from each end of the Set.

The CCTV system shall include the following:

- (a) CCTV cameras and coverage;
- (b) CCTV monitors;
- (c) CCTV operation; and
- (d) CCTV recording and retrieval of images.

The system and recordings shall be of a quality in compliance with the evidence requirements of the Evidence Act 1995 (NSW).

Any image displayed shall be displayed in real-time.

All CCTV cameras shall be turned on whenever a Crew Cab is activated. The internal Passenger area images and the images from the end of Set cameras shall be recorded whenever a Crew Cab is activated. Internal Passenger area images and end of Set images shall continue to be recorded for 60 minutes after deactivation of both Crew Cabs or until the Stable state has been activated.

Internal camera images shall be recorded when Presentation state is active. As a configurable option, this feature may be disabled at RailCorp's request.

The images from all the external cameras and end of Set cameras which are displayed to the Crew shall be recorded when:

- (a) Crew are viewing external images; or
- (b) the Set is within 300m of a station; or
- (c) the Set is in the Normal state and is travelling at 5km/hr or less; or
- (d) the Set is in Presentation state.

The CCTV system shall be configurable so that conditions for activation of cameras and recording of images may be readily changed.

The CCTV system shall include built-in security to prevent configuration changes or tampering by unauthorised persons. Cable routes shall be located such that they shall not be susceptible to Vandalism.

#### 11.10.2 CCTV cameras and coverage

##### 11.10.2.1 Internal Passenger area coverage

Internal CCTV cameras shall provide complete coverage of all internal Passenger areas including:

- (a) All Passenger entry and exit points of the Set;
- (b) Stairways within Passenger Saloons;
- (c) All PEI locations;
- (d) All internal EDR locations; and
- (e) All Vestibules, End Saloons, upper Saloons and lower Saloons.

RailCorp considers it unlikely that adequate coverage of the interior can be achieved without the use of at least 8 CCTV cameras per Car. Each camera shall be readily identifiable within the field of view of at least one other camera.

All internal CCTV cameras shall provide clear images of the internal Passenger areas in accordance with clause 11.10.7.1 for all operational and lighting conditions down to 2 lux under which the Set may operate.

The camera locations and coverage shall be demonstrated and agreed during the Mock-up review.

##### 11.10.2.2 External coverage

External CCTV cameras shall be provided to permit monitoring of the Set/platform interface. The cameras shall be positioned to offer a clear and unobstructed view of the whole of the Set and associated platform area on straight track. On curved track, the view shall be maximised within the limitations imposed by the geometry of the Set and the infrastructure.

The image clarity, angle of view and depth of field shall enable the Guard to monitor the movement of all passengers including children and objects such as prams, between the Set and the platform, and the entire Set to platform interface. The camera lenses shall be selected so that the Guard is provided with a consistent perspective.

The external image clarity, angle of view and depth of field shall provide a clear view of:

- (a) Full height of passengers at each doorway;

RFTA  
00354

RFTA  
00192

(b) Passenger movement along the platform including those with tight curvature; or

RFTA 00302
RFTA 00112

(c) A Passenger who has fallen between the platform and Set and is not entirely below platform level.

PPP Co shall determine the appropriate ~~viewing distance from the Set~~ camera locations to meet the above requirements, ensuring that ergonomic and human factors issues are fully addressed from the Guard's perspective and in consideration of, but not limited to, the situations a), b) and c) above.

RailCorp considers it unlikely that an appropriate level of reliability, redundancy and coverage can be achieved without the use of at least one (1) camera per side of each Car in the Set. This will need to be verified during the Mock-up review and in consultation with RailCorp.

All external cameras with the exception of the external cameras nearest to each end of the Set should be facing in the same direction. The required coverage of each camera shall be covered by the field of view of at least one other camera.

Each external CCTV camera shall provide clear images of the platform interface in the area in which the Set may operate, to the extent permitted by the weather conditions, the ambient, incident and contrasting lighting conditions and the performance of the cameras selected, subject to a minimum ambient lighting level of 2 lux.

Each external CCTV camera shall adapt automatically to the prevailing lighting conditions independently of any other CCTV camera.

PPP Co shall demonstrate the capabilities, locations and coverage of the external CCTV cameras during the Technical Review.

*11.10.2.3 End of Set Camera Coverage*

One end of Set CCTV camera shall be provided at each end of the Set to record the track, infrastructure, other trains and objects on or about the track, to the extent permitted by the weather conditions, the ambient, incident and contrasting lighting conditions and the performance of the cameras selected, subject to a minimum ambient lighting level of 2 lux.

Each end of Set camera shall adapt automatically to the prevailing lighting conditions independently of any other CCTV camera.

The end of Set cameras shall be set up to simulate as far as practicable the view visible to the driver without artificially blocking any area.

The images shall provide clear details of the following:

- (a) Objects on or about the track; and
- (b) Identification of speed boards and signal aspects.

Images from all end of Set cameras shall be recorded whenever any Crew Cab is activated. Viewing of images from these cameras by the Crew is not required.

PPP Co shall demonstrate the capabilities, locations and coverage of the end of Set cameras during the Technical Review.

11.10.3 CCTV cameras

RFTA 00191
---------------

The cameras shall be ~~high quality, robust, easy to replace and commercially readily~~ available. Each camera shall be clearly identified on the recording.

The CCTV camera resolution shall not be less than 800 (H) x 600 (V) pixels and not less than 540 (V) x 400 (H) television lines.

The CCTV cameras shall have a frame rate consistent with their function and not less than 6 frames per second (fps).

*11.10.3.1 Internal Passenger Area Cameras*

The internal CCTV cameras shall be positioned to minimise obstruction by fixtures or passengers.

11.10.3.2 External Cameras

External CCTV cameras shall be positioned to minimise glare from light sources including railway signals, station and other lighting and the effect of reflections and colour contrasts along the length of the Set (e.g. windows, Guard’s blue light).

Appropriate measures shall be taken to avoid the effects of direct sunlight on cameras and minimise shadow effects caused by platform awnings or any other infrastructure.

PPP Co shall use its reasonable endeavours to ensure that cameras and any associated mounting arrangements do not infringe the Medium Width Kinematic Rolling Stock Outline defined in Clause 4.5 by more than the existing rolling stock equipment in similar areas of the Car body. In the event that any equipment does further infringe the Medium Width Kinematic Rolling Stock Outline, PPP Co shall undertake a risk assessment to determine the effect of such infringement, taking into account the structure gauge dimensions.

11.10.3.3 End of Set Cameras

The camera shall be mounted in a fixed position, i.e. after setup they will not be able to move from side to side or up and down.

11.10.4 CCTV Monitors

One colour touch-activated monitor shall be provided on the back wall on each side of each Crew Cab such that when the guard is standing at the crew bodyside door to operate the passenger door controls the guard can quickly switch between observing the Set/platform interface and the CCTV monitor.

RFTA  
00241

In the event that space is not available for the installation of the CCTV monitors, PPP Co shall conduct a ~~trade-off~~ design optimisation study against the following features in the following order, in order to provide space for the CCTV monitors:

- 1) changes to the draughtscreen and setback at the adjacent Passenger bodyside door (clause 6.2.12);
- 2) changes to the width of the Crew transverse door giving access to the adjacent Cab (subject to a minimum clear width of 700 mm) (clause 6.7.5); and
- 3) removal of the seats behind the adjacent Cab (clause 6.2.8 (l)).

The CCTV monitors shall be used to view real-time images of internal passenger areas as well as external camera coverage.

The viewing angles for the monitor shall allow the images to be clearly viewed from each of the door control stations, the guard’s workstation and by a trainer.

Contrast and brightness controls shall be provided for each monitor to enable the Crew to adjust the picture.

PPP Co shall determine the size of the monitors based on the task requirements for image size and clarity. The minimum CCTV monitor size shall be at least a 15” diagonal (or 38cm) with a display resolution of not less than 1024 x 1280.

PPP Co shall determine the location of the monitors in consultation with RailCorp representatives during the Mock-up review and shall ensure that ergonomic and human factor issues are fully addressed. The position of the monitors shall limit ambient light incident upon the monitor screens.

The CCTV monitors shall be separate devices to the TOS display screens.

11.10.5 CCTV System Operation

Failure or ‘freezing’ of any internal or external CCTV image shall be immediately obvious to Crew through an indication displayed on the monitor.

RFTA  
00320

It shall be possible for the Guard to use the touch screen capability in order to increase the size of any of the CCTV images (internal or external), 1 image at a time, with the size increase as a minimum equalling

that of the native camera resolution. Any summary train status information shall remain visible when viewing an enlarged image.

*11.10.5.1 Display of Internal Passenger Area Images*

The method of display of internal CCTV images on a monitor shall enable the Guard to select individual cameras or a group of cameras up to coverage of all cameras on a Car, and shall allow scrolling through images.

Operation of the CCTV monitor and selection of internal images shall be similar to those of RailCorp’s latest passenger Sets, i.e. allowing manual, sequential, random and programmable control of internal images including the image display period.

The default setting shall be for the monitor to display all Set internal images sequentially within a cycle time of 2 minutes.

Car number and camera location shall be provided on each displayed image.

The layout, quality, display and user interface of the internal CCTV images on the monitors shall be demonstrated and agreed during the Mock-up review.

*11.10.5.2 Display of External Camera Images*

When external CCTV images are displayed on a monitor, images from all external cameras on one side of the Set shall be displayed in real-time and be visible simultaneously.

When displaying external images, the CCTV monitor on each side of the Crew Cab shall normally display images for that side only. However, a control facility, local to the monitor, shall be provided for each CCTV monitor in the Crew Cab allowing external camera images to be displayed irrespective of Set side. This control facility shall be utilised in the following circumstances:

- (a) a guard trainer or other authorised person who needs to view the same Set-platform interface as the Guard; or
- (b) as a temporary measure in the event of a CCTV monitor failure.

Car number and camera location shall be provided on each displayed image.

RFTA 00320
00320

The external CCTV images shall be displayed on the monitor as 2 rows of 4 images, with the top row image furthest to the left being that of the car furthest from the Crew Cab occupied by the Guard. The images shall be displayed in order of Cars from left to right and top to bottom with the image on the bottom right being that of the car occupied by the Guard.

The layout, quality, display and user interface for the external CCTV images on the monitors shall be demonstrated and agreed during the Mock-up review.

*11.10.5.3 Cab with Active Guard’s workstation*

The Guard shall be able to use the CCTV monitor to:

- (a) View passenger areas within the Set including passenger behaviour;
- (b) View images associated with a PEI call, fire alarm or EDR activation; or
- (c) View external images of passengers exiting/entering the Set and along the platform interface.

The CCTV monitors in any Crew Cab with an active Guard’s workstation shall continuously display internal passenger area images unless:

RFTA 00022
---------------

- i) A PEI or Internal EDR device is activated or a fire alarm is triggered. In this event, except for the conditions stated in Clause 6.7.2.3, all monitors in the cab shall then display the image from the camera giving coverage of the PEI, EDR device or fire detection system alarm, together with an appropriate indication of the location and reason for the display;



ii) the Set is at a point 300m before a station at which it is scheduled to stop. At this time external camera images need to be viewed on the appropriate platform side monitor until a point 300m beyond that station. The distances shall be independently adjustable on demand and at no cost to RailCorp;

iii) the Guard has selected the display of external camera images (for example, if a Set makes an unscheduled stop). In this case, the display of images relating to condition i) shall override this selection; or

iv) the Guard has selected a blank screen with negligible light output for a local monitor. In this case, the display of images relating to conditions i) and ii) shall override this selection.

#### 11.10.5.4 Cab with Active Driver's workstation

It is currently intended with two-person Crew, that the Driver shall not be able to view any CCTV images from their normal driving position.

The monitors located in a Crew Cab with an active Driver's workstation shall default to a blank screen with negligible light output to avoid distracting the Driver. In the event there is a need for a Driver or other authorised persons to view CCTV images, the selected monitor shall display any Internal Passenger Area image including PEI, EDR activation or fire detection system alarm. In this event, once the Set is moving above 5 km/h the monitor shall return to the blank screen unless touched again.

RFTA  
00240

In the event that a Guard and a Driver are operating from the same Crew Cab, ~~then~~ the CCTV monitor behind the Driver operation shall be as per Clause 11.10.5.3 shall default to a blank screen with negligible light output until touched. The CCTV monitor behind the Guard's workstation shall default to a blank screen with negligible light output until touched except for alarm messages which shall be displayed automatically.

#### 11.10.6 CCTV Camera Housings

##### 11.10.6.1 Internal CCTV Camera Housing

All internal cameras shall be housed in vandal-resistant housings that comply with clause 6.11.3 (Vandalism) and have an IP rating 'IP54' as defined in AS 60529.

The camera housings shall not have any gaps or voids around the housings and shall resist tampering and vandalism.

All exposed fasteners accessible in the Passenger areas and the Crew Cabs including screws, nuts and bolts shall be of a tamper-proof, security fastener design.

##### 11.10.6.2 External CCTV housings

All external cameras shall be housed in vandal-resistant housings that comply with clause 6.11.3 (Vandalism) and be robust and suitable for the environment in which the Set will operate. This includes: dust and driving rain whilst travelling at high speed and cleaning in the Set wash facilities.

The housing shall comply with IP66 as defined in AS 60529.

The environment within the external CCTV camera housings shall be controlled to ensure that the image quality is not adversely affected by any combination of conditions within or external to the camera housings.

The design of the external camera system shall minimise the amount of cleaning required whilst maintaining image quality.

#### 11.10.7 Recording and Retrieval of CCTV images

##### 11.10.7.1 Recording Resolution

The system shall record all images in compliance with the evidence requirements of the Evidence Act 1995 (NSW). The CCTV system shall incorporate security features to prevent tampering or corruption of recordings. Any attempt at tampering or corrupting images shall be identified.

RFTA  
00188

The CCTV images shall be recorded at ~~full PAL~~ no less than 800H x 600V frame resolution and at the frame rate at which the images were captured.

~~The images shall be able to be exported and played back at full PAL frame resolution and picture quality.~~

The CCTV system shall further provide images of sufficient quality to enable the identification of a person within its field of view in all anticipated light conditions.

*11.10.7.2 On-Set Storage*

All images shall be stored in two separate non-adjacent Cars on the Set to provide redundancy of storage in the event of equipment failure and Set incidents. These storage units shall not lose data under Failure conditions.

RFTA  
00354

*11.10.7.3 Storage Time*

All camera images shall be recorded and maintained for at least ~~30~~20 days before being overwritten.

*11.10.7.4 Date and Set Location Recording*

All images shall be stamped with the Car number, camera location, time and date of recording and an indication of the location of the Set on the Rail Network. The form of Set location indication is to be agreed with RailCorp.

*11.10.7.5 Physical retrieval of images*

Only authorised staff shall have access to physically retrieve all images from the Sets. The physical retrieval method shall maintain data integrity and include a clear evidence trail in compliance with the evidence requirements of the Evidence Act 1995 (NSW).

RailCorp shall be able to use its standard physical retrieval protocol to manage this process. The time to retrieve all recorded images from the Set shall not exceed 2 minutes.

Unless otherwise specified, PPP Co shall supply two (2) sets of all necessary tools and equipment required to perform such retrieval.

*11.10.7.6 Downloading of images*

Only authorised staff shall have access to download-by-software (such as through the use of a file transfer program) images from the Sets. The software download method shall be through a non-proprietary, industry standard, digital interface. The software download method shall maintain data integrity and include a clear evidence trail in compliance with the evidence requirements of the Evidence Act 1995 (NSW).

Downloading of recordings shall not remove, delete or otherwise compromise the original recording.

RFTA  
00354

PPP Co must ensure that RailCorp is able to use its standard software download protocol to manage this process. The time to retrieve a full day of recorded images from the Set shall not exceed ~~60~~90 minutes.

Unless otherwise specified, PPP Co shall supply two (2) sets of all necessary tools and equipment (including hardware and software) required to perform such download.

*11.10.7.7 Off Set viewing of images*

Images and associated data downloaded or retrieved from a Set shall be able to be reviewed and published using non-proprietary, industry standard components and software.

Unless otherwise specified, PPP Co shall supply two (2) sets of all necessary hardware and software required to perform such viewing and publication including export of images and sequences of images whilst maintaining data integrity and including a clear evidence trail in compliance with the evidence requirements of the Evidence Act 1995 (NSW).

The image viewing system shall include a search facility. The images and associated data shall be able to be searched by car, camera, time, date and activation of any PEI, EDR or fire alarm.

The retrieved images shall be able to be exported to CD, VCD, DVD or other agreed media and format as individual images or as a sequence of images for a selected time period.

RFTA  
00188

The images shall be able to be exported and played back in both original recorded format (800H x 600V) and in full PAL frame resolution and picture quality.

Off-Set viewing shall also be available using a standard laptop computer or similar.

*11.10.7.8 Printing of retrieved images*

The downloaded or retrieved images shall be able to be printed out individually or as a sequence of images for a selected time period. The printout shall include all identifying information for the images.

Unless otherwise specified, PPP Co shall supply two (2) sets of all necessary non-standard hardware and software required to perform such printing.

11.10.8 Future Proofing

The Sets shall comply with the requirements specified in Clause 13.2 for CCTV requirements in relation to conversion to Driver only operation.

The Set shall expose to other systems (such as CTIP and DTR) the following services (listed in Table 15 below) via the RailCorp Data Link:

Transaction	Description	From	To	Frequency of Transaction
CCTV Data Streaming	Stream live CCTV footage from up to two cameras on a nominated Car and locations on a Set.	PPP Set	RailCorp	Weekly
CCTV Data retrieval	Retrieve CCTV data from a Set for a specific time period or specified location boundary	PPP Set	RailCorp	Daily

**Table 15: CCTV Transactions**

**11.11 Digital Voice Annunciator**

A Digital Voice Annunciator (DVA) shall audibly advise Passengers of the timetabled destination and route information of the Set. The announcements shall be derived from the timetable information held on the Set.

The DVA shall require minimal attention from the Crew and operate in conjunction with the TOS, and relevant communications devices to allow remote setting, control and updating of the DVA system including its announcements, timetables database and other associated information.

The Driver and Guard shall have the facility to repeat, skip, add or cancel any announcement prior to or during that announcement.

Stops can be added or removed on a “one-off” basis at the start of or during the currency of that trip. Where stops are added or removed the amended stopping pattern and destination shall be accurately represented by the DVA.

The current and next announcements shall be displayed to the Crew as text. The Crew shall have the facility to insert special announcements into the queued announcements at any time with minimal operation of the controls.

The DVA shall interface to the Public Address system.

Irrespective of whatever method is used to reprogram or update data, the process shall ensure error free and secure transfer and revision of data. Maximum on-vehicle data transfer times from a portable download device, for whatever data the combined DVA and display subsystem uses, should be limited to 6

minutes for a complete system data renewal or initialisation and 3 minutes for a major but partial data revision that would be expected with introduction of a new Timetable. Nevertheless, PPP Co shall make every endeavour to ensure that on-vehicle data download times are half the above values or better. These times include any actions or initiating keystrokes to start transfer after the data port connection has been made until all data is confirmed to have been successfully transferred.

All systems shall be self-testing and shall alert the Crew to any Failure or malfunction.

The Crew shall have the capability to reset and/or isolate the DVA and revert to Crew announcements in the event of non-self-correcting DVA malfunction.

The DVA equipment shall be simple to operate and highly resistant to abuse, Vandalism, cleaning agents and cleaning processes.

PPP Co shall take into account that the primary duty for the Crew is to operate the Set. The DVA shall not distract the Crew or interfere with Set operations.

The DVA shall be indistinguishable from high quality live announcements and shall include the frequency range of 800 – 2000 Hz to give best audibility for hearing impaired Passengers.

The frequency response for the DVA shall be constant (flat) within 3 dB(A) for the range from 60 to 10,000 Hz with any tone controls set for a flat response. The frequency response for the DVA shall be suitable for announcement tones or chimes.

The DVA shall be capable of continuous operation.

All messages and their presentation shall be proposed to RailCorp for approval.

The DVA announcements and their timings shall be configurable by RailCorp without the need to change the hardware, firmware or software. The DVA system shall include the ability to produce tone signals that can be used to replace voice messages should RailCorp wish to change the configuration.

The default messages for DVA and internal destination indicators for each mode of operation shall be as per Appendix A – Digital Voice Annunciator and Internal Destination Indicator Operation. The final message set shall include the ability to add station names to messages, link messages and set messages to repeat and shall be agreed with RailCorp during the Contract Term.

#### 11.11.1 Approaching Station Announcement

In the automatic mode as the Set approaches a timetabled stop, the DVA shall inform Passengers of the name of the station (Next stop [station name]) approximately 250m before the station stopping point, allowing sufficient time for Passengers to move to the Vestibule areas before the Set is stationary.

#### 11.11.2 Departing Station

In the automatic mode the required DVA announcement shall be triggered after the Set has travelled approximately 250 metres from the starting position. The DVA shall not be affected by false starts or multiple door openings and closings while the Set is at a station platform.

#### 11.11.3 DVA Messages

All words and place names to be displayed on the equipment shall be in the English language sentence case and shall be spelt and pronounced correctly.

Messages shall be stored in high reliability non-volatile storage device and shall be readily expandable for future enhancements.

The capacity of the DVA storage device shall be sufficient to announce the names of all stations that CityRail rolling stock may stop at with introductory phrases, connecting words and announcements for emergencies, delays and special events. Capability shall be provided to handle differing speech inflections for words and phrases that can be used at the beginning, middle or end of announcements.

The DVA shall include the facility to switch between two volume levels, manually and automatically at programmable times (at least three low and three high periods per day) and locations (announcements at particular locations) and the level shall be indicated to the Crew.

The DVA shall include the facility for the Driver or Guard to append automatic announcements such as "join buses" or "change trains" to any announcement referring to a particular station at any time during the currency of a particular route code and repeat the message at all stations. This shall be cancelled when a new route code is entered or the route code is updated.

The DVA shall display to the Crew the time of departure from the next stop.

The DVA shall provide an audible tone or chime to be heard by the Crew that shall be triggered in conjunction with a particular location (station within the route code/stopping pattern) (tone/chime 1).

The DVA shall provide an audible tone or chime to be heard by the Crew that shall be triggered at completion of the current route code/stopping pattern (tone/chime 2) and be readily differentiated from other audible cues to the Crew.

The two tones or chimes shall be readily discernible by type, pitch or duration.

The DVA shall provide an announcement attention tone or chime for which the default operating mode may be switched on or off via the software, and may change from one message type to another.

11.11.4 DVA Controller

The DVA controller shall control the information announced by the DVA.

The DVA shall have the following modes of control available:

- (a) Single (manual) - the Driver or Guard shall scroll through a menu list to select an announcement then activate the announcement when ready.  
The menu list shall include "next stop is (station)" for all stations;
- (b) Manual (Semi-Automatic) - The Driver or Guard enters a route or stopping pattern code and then activates each announcement when ready and the announcements step through a pattern suitable for that route code;
- (c) Automatic - The Driver or Guard enter a route or stopping pattern code. Thereafter, the DVA shall monitor sufficient inputs to reliably determine that the Set has departed from the station and thereby increment the DVA to the next announcement and trigger that announcement when appropriate; and
- (d) Remote (Fully Automatic) – Whilst it is not intended to activate remote (full automatic) control at this stage the facility to do so, including the requirements for minimal attention from the local Crew shall be available. Remote mode shall incorporate the features of Automatic mode which shall incorporate the features of Manual mode which shall incorporate the features of Single mode. For remote (fully automatic) operation, the full suite of DVA services shall be exposed to the RailCorp Data Link, including the transactions listed in Table 16 below:

Transaction	Description	From	To	Frequency of Transaction
Update DVA timetable data	Updates the DVA with new timetable data for the current run	RailCorp	PPP Set	Frequently (>3 per day)
Update DVA Data with audio & text files	Send, sustain, and cancel messages from the PA and DVA systems	RailCorp	PPP Set	Frequently (>3 per day)

Compose DVA Message	Sequence automated message from component messages	RailCorp	PPP Set	Frequently (>3 per day)
Enable/Disable automated operation of the DVA	Change DVA mode of operation	RailCorp	PPP Set	Daily
Annunciate Timetable Message	Initiate DVA announcement	RailCorp	PPP Set	Frequently (>3 per day)

**Table 16: DVA Transactions**

11.11.5 DVA Operation

The number of operations required to enter or clear a DVA announcement and route code shall be equivalent to the number of operations used in respect of Millennium Trains.

The information and codes held in the DVA controller shall not change due to power fluctuations or on the removal of power.

The DVA shall reset the current route code and announcement information after a period of thirty (30) minutes with the Crew Cab deactivated.

The "current route code and announcement" information held in the DVA shall not change on power fluctuation or removal for periods of less than thirty (30) minutes.

If the power is removed for more than thirty (30) minutes then the announcement on power up shall be reset to cause the DVA to go silent and the controller display blank.

It shall not be necessary to clear old DVA information from the Controller before entering a new DVA code.

11.11.6 DVA Programming & Recording of Announcements

It shall be simple to generate or record announcements.

The DVA timing shall be consistent with other time signals on the Set.

If a route or announcement code (stopping pattern) is set before the pre-programmed changeover time then that route or announcement code and the associated announcements shall not changeover until it is cancelled, reset or a new route or announcement code is entered.

11.11.7 DVA Door Opening Announcement

When the doors are opened at a timetabled stop the DVA shall inform Passengers of the name of the station, the destination station and the next station. Subject to timing the Guard may be able to add on additional train stopping information.

At certain stations the DVA shall make an additional announcement as the doors are opening. This announcement is anticipated to be "Mind the gap" or a similar phrase and would be broadcast at particular stations only. The list of stations will be identified to PPP Co during commissioning and may be changed thereafter in a similar manner to a timetable change. These announcements shall be able to be broadcast on internal and external speakers. In addition, on door opening, the DVA shall be capable of announcing Set destination and stopping information.

**11.12 Radio Systems**

The Set shall be fitted with the with a Train Radio system that has the same functionality as that described in 11.12.1 Train Radio and 11.12.2 Hand Held Train Radio.

### 11.12.1 Train Radio

#### 11.12.1.1 Overview

RailCorp currently operates a Metropolitan wide Train Radio system called MetroNet.

All new Sets will be required to include equipment, which will allow communication to this network.

The MetroNet System has a projected remaining service life of approximately 5-8 years. Plans are currently being formulated to define the requirements of its replacement system. This will almost certainly take the form of a system built around a digital radio platform and is colloquially known as Digital Train Radio. The Sets shall have the capability of having Digital Train Radio equipment fitted in the future.

The Train Radio equipment shall have the capability to send a signal to the land-side fixed equipment on receipt of a contact closure from the Set systems. PPP Co shall configure the train systems to deliver this contact closure to the Train Radio when the Driver Safety Systems are not maintained when the Set is in the Normal state and the Driver Safety Systems would normally be maintained. For the purposes of this clause only, the definition of a Driver Safety System shall exclude the Safety System Suppression Emergency Button. PPP Co shall additionally provide a facility for both Crew members to be alerted, prior to this signal being sent, to enable either Crew member to cancel the signal being presented to the Train Radio equipment. Should the Driver Safety Systems not be reset after a time interval, to be agreed during the commissioning phase, then sending of the signal shall be re-initiated.

RFTA  
00306

The Train Radio also shall have the capability to direct an incoming radio audio message to an alternative source other than the Driver's radio handset. This capability shall be initiated on receipt of a signal from the Train Radio equipment by way of a contact closure. The communications system shall allow RailCorp operational staff based in control rooms or signal boxes to be able to directly communicate with Passengers throughout all Passenger areas using the internal Public Address. Communication with Passengers outside the train standing on platforms shall be also included. All communication shall be one-way from the land-side radio system via the Train Radio to the train's Passenger communications system.

The Train Radio shall include the capability for any Crew member to listen to any other Crew member's conversations.

#### 11.12.1.2 MetroNet Equipment

Each Crew Cab of a Set shall be equipped with its own MetroNet radio equipment with the radio power being supplied via a protected Miniature Circuit Breaker (MCB).

The on-train MetroNet system is composed of the following items of equipment and their associated cabling and connectors.

##### 11.12.1.2.1 Radio Antenna (405-420 MHZ)

The current trains use a roof mounted antenna, within loading gauge, positioned to provide omni-directional coverage with vertical polarisation of the RF signal.

The antenna shall present a RF match to the main radio equipment of better than 1.2:1 voltage standing wave ratio and the feeder cable connecting it to the RF equipment shall have no greater than 3dB loss.

##### 11.12.1.2.2 Under Train Transponder Interrogator Antenna

This device detects the Set passing over track mounted transponders, which contain information about the settings of the MetroNet radio as it moves through the Sydney Metropolitan Network. The unit shall be mounted in accordance with the manufacturer's instructions in relation to height above rail, track centre line and clearance from other equipment. It is connected to the interrogator reader unit with a four-core communications cable.

11.12.1.2.3 Interrogator Reader Unit

The interrogator reader unit is connected to the under train antenna, the radio unit and the Cab Occupied Relay (see below). The unit interprets the messages read from the track transponders and formats the message into a data stream, which the MetroNet radio can interpret.

11.12.1.2.4 Power Supply

The power supply also contains a Cab occupied relay, which is connected to a train control line, representing the status (i.e. Drivers Workstation active) of the Cab the equipment serves, to a control signal for the IRU and main MetroNet Radio.

11.12.1.2.5 Radio Control Head

This is manufactured by Siemens. The radio control head provides the Crew's interface for the MetroNet system. It contains buttons and displays, which are used to operate the radio. It is a "free standing" unit which can be either mounted in a workstation, by use of an appropriate bezel or mounted in its own case above or to the side of a workstation. The exact location of the unit in any layout depends upon the positioning of other controls. The control head shall be within the Crew's normal sight line and positioned so that the buttons can be operated while the Crew is in the normal, seated position

11.12.1.2.6 MetroNet Radio Unit (MRU)

It contains the main radio and the interfaces to the associated Train Radio equipment. The unit is powered by nominal 12 Volts dc. Apart from connections and interfaces to the other equipment forming the main Train Radio installation the unit has a number of interfaces which shall be catered for, although some of these are not currently enabled in the existing installations:

- (i) Data to/from radio control head;
- (ii) "Emergency Call" button input from the control head – this may also be an additional Cab mounted button;
- (iii) Audio signal to separate train radio Cab loudspeaker, nominal 8 Ohms impedance, 8 watt power;
- (iv) Audio to / from Drivers handset system, including a handset Push To Talk (PTT) control function. Note; no cradle rest signal is utilised or required;
- (v) Input from 'Drivers Safety Device' – not currently used;
- (vi) Audio output @ 600 Ohms, Line Level, to On-Train Public Address system - not currently used;
- (vii) On Train Public Address enable control signal - not currently used; and
- (viii) Data output to other on-train system, a RS 422 signal @ 1200 baud - not currently used.

11.12.1.2.7 Interconnection Terminal Strip

A terminal strip to connect all of the MetroNet equipment is required to facilitate testing and maintenance activities.

11.12.2 Hand Held Train Radio

The Crew Cab shall include a mounting space for a holster to holding a Train Radio compatible hand portable radio.



Cabling, conduits, terminations and bracketry shall be installed to enable the later fitment of a holster with a radio charging facility

~~When in the holster~~ When the future charging holster is installed, the radio shall connect to a charging point, which shall be active when the Set is operating on the OHW power supply.

~~The hand held radio shall also be capable of working in the WB Mode.~~ The Train Radio compatible hand portable radio is not required to be supplied with the Sets.

### 11.13 PPP Co Data Link

The PPP Co Data Link shall be provided and supported by the PPP Co and implemented before the Delivery Testing.

PPP Co shall provide each Set with a Data Link enabling PPP Co to perform remote Set management tasks required to achieve availability, reliability, safety and other Set performance targets as specified by the Contract.

This PPP Co Data Link shall connect PPP Co's Set-borne systems with PPP Co's Shore-based ICT systems and shall be considered (with respect to other communications channels that may be established):

- **independent:** the PPP Co Data Link is able to transmit and receive data without dependence on other communications systems;
- **isolated:** the PPP Co Data Link is not capable of impacting the operations of other communications systems;
- **secure:** protection shall be established preventing unauthorised or harmful use of the PPP Co Data Link; and,
- **global:** the PPP Co Data Link is able to transmit and receive from any point on the RailCorp Network;

PPP Co shall ensure all necessary equipment is provided to facilitate the collection and transfer of data over the PPP Co Data Link.

The PPP Co Data Link shall be implemented in accordance with publicly available ICT wireless network standards.

The PPP Co Data Link shall not be implemented with a dependency on current or future RailCorp Set-borne systems such as: MetroNet, Digital Train Radio, and CTIP.

### 11.14 Commercial Radio

The Crew Cab shall be provided with a commercial radio capable of receiving all normal commercial radio broadcasts on the AM and FM bands. The commercial radio shall have the ability to tune to and receive all broadcasts that could be expected to be received in the area in which the Set is operating.

The commercial radio shall only be available when the Cab is occupied by authorised staff.

The commercial radio unit shall be mounted within the Crew Workstation area, in such a way as to prevent unauthorised removal and within arm's length of a seated Crew member.

The commercial radio shall be heard through two 15cm speakers preferably mounted in the Cab ceiling but separated from other speakers or communication and signal sources to ensure that these signal sources are distinguishable from the commercial radio. The radio and speakers shall be capable of providing stereo reception where available. The quality of the installed performance of the commercial radio shall be optimised to the extent possible using the installed equipment and reception shall be similar to that achieved in the 4GT trains at comparable sites and under comparable conditions. ~~received signals shall not be subject to interference from any on-board systems.~~

The maximum sound level generated by the commercial radio shall be limited to approximately 80 dB(A), and below the sound level of the bell and horn signals.

The commercial radio shall have provision for at least six station presets on each band, as well as an auto-roam feature. There shall be a minimum number of controls available on the radio.

---

The on/off, volume and tuning controls shall be adjustable from the normal driving position.

The commercial radio shall not incorporate any headphone socket.

The commercial radio shall be fitted with an automatic interrupt feature to interface with the Set in such a way that the commercial radio is silenced when the Crew is transmitting and receiving messages. The automatic interrupt feature shall incorporate a delay to permit replies to be transmitted and received before the commercial radio is reconnected.

The automatic interrupt feature shall operate under the following conditions:

- (a) Operation of Passenger Emergency Intercom;
- (b) Operation of intercom;
- (c) Operation of the Public Address, including DVA;
- (d) Train Radio call;
- (e) Bell signal;
- (f) Vigilance Control warning;
- (g) When any Crew Cab bodyside door is not closed; and
- (h) Any other audible warning alarm.

The automatic interrupt time out shall be adjustable from 1 s to 30 s or to shut down until restarted by the Crew.

The Crew shall be provided a time out override switch to reconnect the commercial radio once the data exchange has been completed.

### **11.15 Global Positioning Satellite System (GPS)**

#### **11.15.1 Overview**

A number of on-train information systems require knowledge of the Set's actual position within the Rail Network including the on-train Passenger information displays and the automated Public Address/DVA system. GPS equipment shall be provided and used to meet these needs.

The position location system shall be able to provide information to other on-train systems – to provide control to systems and to enable continuous logging of Set position. The interface shall be via a data communication port using NMEA-183 protocols.

The location, determined by the GPS, and available to other on-train systems, shall be accurate to better than 50 metres.

The GPS equipment shall output time in UTC format, which shall be distributed and used by the Set to coordinate all time requirements by on-train systems. The distribution system shall be capable of maintaining on-train time accuracy to better than 5 seconds per month in the periods when GPS time information is not available.

#### **11.15.2 Operating Environment**

PPP Co shall consider mechanisms which overcome the reception and accuracy problem typically encountered by GPS Systems within the Rail Network.

The following should be addressed:

- (a) Urban canyon, deep cuttings, tunnels and frequent over bridges mean that GPS coverage is not continuous. Systems shall have additional functionality to compensate for this. Vehicle dead reckoning and inertial navigation assistance are appropriate technologies;
- (b) GPS accuracy for a moving Set may not be adequate without the additional refinement of differential GPS (D-GPS). There are a number of D-GPS systems that function in the Sydney area. While

---

improving positional accuracy these systems do not overcome the difficulties of non continuous GPS signals mentioned above; and

- (c) When used for automated announcement and Passenger display functions the GPS information, when processed by the System's control unit, shall take account of actual Set speed and platform position, before triggering announcements and display messages. It should be noted that monitoring of door opening and closing can be utilised as confirmation that the Set is at a station.

#### 11.15.3 GPS Equipment

GPS equipment shall comply with the following:

- (a) Be robust and suitable for use in a train-borne environment;
- (b) Provide a minimum of 12 channel parallel reception;
- (c) Have receiver operation, bandwidth and performance to cater for the American L1 range;
- (d) Be installed with an on-train roof antenna to match the receiver performance. If D-GPS receivers are proposed it is preferred that the antenna functions for both the GPS and D-GPS signals;
- (e) The antenna shall be powered via the RF feed cable;
- (f) The antenna position, with respect to the receiver, and feeder cable chosen, shall be such that no more than 3dB attenuation occurs in the RF feeder cable in the L1 band;
- (g) The equipment, including antenna shall not be affected by other Set systems, in particular the transmissions from transponder interrogator readers and Train Radio, both MetroNet and future Digital Train Radio;
- (h) Provide NMEA 0183 standard operation; and
- (i) Output NMEA message codes on an auxiliary port for use by other on-train systems at a rate of 1 position fix per second or faster.

### 11.16 In-Car Visual Passenger Information Displays

#### 11.16.1 Overview

Each Car shall be provided with visual announcement displays.

The displays shall show information to match the automated announcements of the DVA.

A minimum of six displays shall be provided per Car. The type of display, character size, colour, brightness and positioning shall be such that every seated Passenger position and Wheelchair Space shall be in visual range of a display for person having 6/18 vision.

The display control system will operate in conjunction with the automated announcement system to ensure that displayed messages match announcements in timing and content.

The DVA system controller functionality shall include control of the visual displays.

When either the Guard or Driver uses the manual Public Address facility the display shall say "Guard Announcement" or "Driver Announcement" as appropriate with international symbols for deafness.

#### 11.16.2 System requirements

The display system shall comply with the following:

- (a) Font sizes shall be compliant with DSAPT requirements for viewing distance;
- (b) Displays shall be visible in all lighting conditions;
- (c) Displays shall be designed and housed for Vandal resistance;
- (d) Display housings should be designed into the overall design of the Set such that they are fully integrated and do not convey an “added on” appearance;
- (e) Displays shall incorporate a fault monitoring facility to report faults to the Train Operating System;
- (f) The display control system shall be capable of sending a test message to each display for use by Crew when preparing the Set. This message shall enable any single failed display element to be detected;
- (g) Shall have sufficient display area to show the final destination and stopping pattern, scrolling if necessary;
- (h) Both Upper and Lower case fonts shall be displayable;
- (i) The display matrix size shall be capable of displaying a reduced number of larger characters, in upper and lower case;
- (j) Fonts shall be designed to maximise the clarity capability of the delivered display. The proposed character fonts shall be supplied for approval by RailCorp and compliant with DSAPT. Text shall be displayed in English sentence case. Text shall provide maximum colour contrast to its background. Yellow text on black background is preferred;
- (k) Messages shall be able to be scrolled in either the horizontal or the vertical direction as defined in the message script;
- (l) A minimum of 24 characters shall be visible at any one time;
- (m) Changes to the automated announcement script shall be reflected in the displayed message script; and
- (n) A system with similar format and appearance to the most recently introduced RailCorp electric Cars is preferred.
- (o) Display screens shall have 3M safety and security film specification type SH8CLARL applied to the external surface, post installation of the displays into Cars. Film shall be applied to display screens by 3M licensed installers only. Film shall be pre-cut to exact sizes by installers using Computer Numerically Controlled cutting techniques. Detailed trimming of film in-situ will not form part of the application process. Film application methods shall be designed to facilitate ease of future replacement.

RFTA  
00322

11.16.3 Services

For automated local and remote operation the full suite of visual passenger information display services shall be exposed to the RailCorp Data Link, including, the transactions listed in Table 17 below:

Transaction	Description	Transaction Initiator	Recipient	Frequency of Transaction	Style of Transaction
Update passenger information display timetable data	Updates the passenger information displays with new timetable data for the current run	RailCorp	Set	Frequently	Ad-hoc Request
Update passenger information display data with audio & text files	Send, sustain, and cancel messages from the passenger information displays	RailCorp	Set	Frequently	Ad-hoc Request

Compose passenger information display message	Sequence automated message from component messages	RailCorp	Set	Frequently	Ad-hoc Request
Enable/Disable automated operation of the passenger information display	Change passenger information display mode of operation	RailCorp	Set	Daily	Ad-hoc Request
Announce Timetable Message	Initiate passenger information display announcement	RailCorp	Set	Frequently	Ad-hoc Request

**Table 17: Passenger Information Display Transactions**

**11.17 Set Headboard Information**

The Set front end shall include a headboard display that shall display the destination and route number of the Set. The headboard display shall be static, visible under all lighting conditions and shall be mounted in a location that is similar to the current CityRail fleet.

The displayed information shall be clearly legible to persons external to the Set with 6/12 at distances illustrated in Appendix O - Destination Indicator Viewing Envelope.

The font height shall be a minimum of 70 mm and shall be as large as practicable consistent with the ability to display destination station names in full without vertical or horizontal scrolling. The headboard shall have the capacity to display both alpha and numeric characters.

The display system shall also comply with paragraphs (c), (d), (e), (f), (h), (j), and (n) of clause 11.16.2 above.

## 12 Mock-Ups

### 12.1 Interior Design Workshops

Preliminary design concepts for both the exterior appearance and the interior arrangement and furnishings will be established through the Technical Review process defined in the Contract Management Requirements. These design concepts shall be based on, and consistent with, those submitted in the Train Design Book. In addition to making design submissions covering the relevant Set elements PPP Co shall undertake design development workshops with RailCorp representatives to cover all aspects of the internal and external design prior to commencing construction of the Mock-ups. These workshops shall include the input of an access consultant, a transport ergonomist and an interior transport designer all of whom shall be employed by PPP Co. and shall be supported by the use of full size modelling and other simulations to develop individual elements of the Set design.

Letter  
RC00273

RailCorp anticipates that the development of the full Mock-up for the Crew Cab and Guard's Cab will be preceded by partial Mock-ups to test out and develop the design. The methods used shall be such as to provide a good representation of the design features to enable their evaluation.

PPP Co shall propose a schedule of these workshops for acceptance within four weeks of date of Contractual Close.

### 12.2 Required Mock-Ups

PPP Co shall construct full-scale Mock-ups as set out in clauses 12.2.1 to 12.2.3 below.

#### 12.2.1 Car Interior

The interior of half a Car including two Wheelchair Spaces, the complete inter-Car gangway, door entry Vestibule area including doors and Emergency Door access steps. The Mock-up for the Passenger compartment, Vestibule and end Passenger compartment shall include close representations of actual items for all surface finishes, all visible interior equipment and storage compartments and shall be consistent in appearance with a finished Set. In carriage visual Passenger information displays shall be active and displaying representative data. The interior Mock-up shall also be used to access the deployment and use of the wheelchair boarding ramp. Clear and compliant access for mobility aids and manoeuvrability particularly in relation to access path width and handrail and handhold provision shall be demonstrated.

#### 12.2.2 Crew Cab

A Crew Cab including the interface with Passenger areas, nose cone of the front carriage (taking account of vehicle structural requirements), external access, detrainment ramp, wheelchair boarding ramp, and all Cab equipment shall be provided. All controls shall move as intended in the final design. Surface finishes shall be consistent with the final design and colour. Items such as gauges and controls may be simulations of the real items. Details of air conditioner supply and return grille positions and type shall be included in the Mock-up process.

#### 12.2.3 ~~Guard's Cab~~ Not Used

Letter  
RC00273

~~A Guard's Cab including the interface with Passenger areas, external access and all Cab equipment shall be provided. All controls shall move as intended in the final design. Surface finishes shall be consistent with the final design and colour. Items such as gauges and controls may be simulations of the real items. Details of air conditioner supply and return grille positions shall be included in the Mock-up process.~~

### 12.3 Mock-Up Consultation

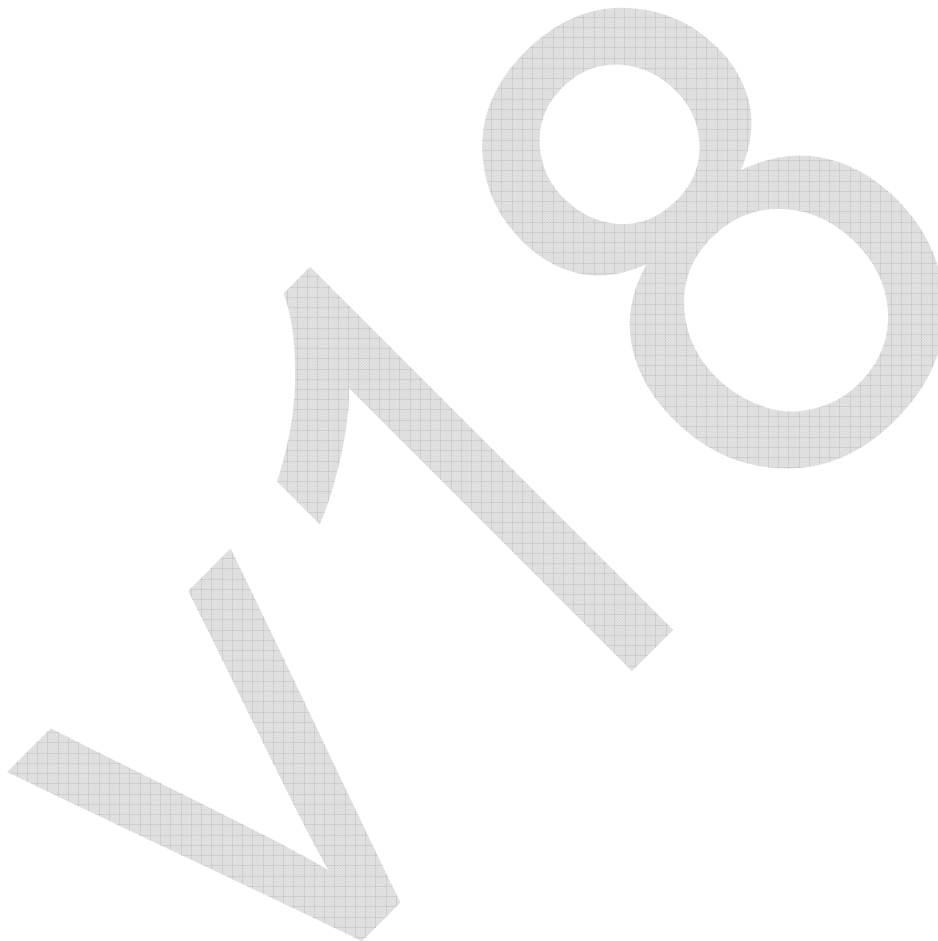
The Mock-ups shall enable RailCorp and its representatives, stakeholders, Passengers, Guards, Drivers, etc, to effectively understand and assess all ergonomic, access and appearance aspects of the proposed

design. The Mock-up shall be sufficiently robust to enable adequate inspection by RailCorp's nominated stakeholders and representatives.

Easy access into the Mock-ups for disabled representatives shall be provided. The Mock-ups shall be located within the Sydney Metropolitan Area.

Mock up seating shall be adequate to give an indication of Passenger and Crew space such as shoulder room and legroom and of seat comfort.

Development of the Set interior and exterior layout will be an iterative process. During the Mock-up stage of the Contract PPP Co shall upgrade the Mock-up promptly to take account of required changes and to enable completion of the design review within timeframes specified for the Project.



## 13 Future Support for Design Life

### 13.1 General Requirements

RFTA  
00164

The Sets and all Systems and Subsystems shall ~~not readily become out-dated~~ be capable of being maintained and have continued component support to the end of the prescribed design life of 35 years and shall not be made rapidly redundant.

All additional equipment shall be new and comprise well-known brand items from reputable manufacturers. Replacement or refurbished equipment shall be supplied by established Australasian distributors with a substantial New South Wales parts holdings and New South Wales technical support.

PPP Co shall guarantee the refreshing of any item of CCTV infrastructure, and the upgrade of software on a regular basis.

### 13.2 Driver Only Operation

The Set shall be designed to be operated initially by a two-person Crew, consisting of a Driver and Guard, who shall normally operate in separate compartments. The design shall permit a later conversion of the Set for Driver only operation with minimum cost and downtime.

#### 13.2.1 Driver Only Application

For Driver only operation, it shall be possible to operate the Set without requiring the Driver to leave the Driver's seat at any time.

The Driver shall be able to:

- (i) Remotely view the exterior of the Set for the length of the Set particularly all Passenger side doors and the close vicinity around each of the doors down both sides of the Set, one side at a time depending on side of door opening;
- (ii) View monitor(s) and the track ahead; and
- (iii) Fully operate the Passenger door controls, DVA and PEI systems.

The number of monitors shall be of a quantity such that coverage of all doors on any one side of the Set shall be achieved while providing a reasonable number of clear, discernible images on the monitor(s) of Passengers entering and leaving each doorway. A maximum of 8 images shall be displayed in colour, in a logical layout and be of sufficient size and clarity to allow a Driver to clearly view each Passenger doorway and surrounding area when seated in the driving position.

#### 13.2.2 Driver Only Equipment

To cater for possible future conversion to Driver only operation, the Driver's Cab shall be provided with the following:

- (i) Capability to show internal and external images on any of the two TOS screens;
- (ii) Capability to increase the size and resolution of the TOS screens to accommodate adequate number of images as described in Clause 13.2.1;
- (iii) Automatic switching between the TOS and CCTV displays on station approach and at speeds chosen by RailCorp;
- (iv) Monitors that provide sufficient clarity that allows view of the Passengers embarking and disembarking the Set to ensure that incidents on the platform or in the doorway are detected. The position of the monitor(s) shall not interfere with the Driver's visibility of signals and track, or cause any reflections on the front windows. Even with the monitors operating, RailCorp Set instruments (such as brake pressures, speed etc) shall remain on display to the Driver at all times;



- (v) Space allocation and wiring for one additional monitor on the Driver's Workstation. The diagonal dimension of this monitor shall be maximised and shall not be less than 10.5" (26.5 mm);
- (vi) Space allocation and wiring for door control panels on the Driver's Workstation; and
- (vii) Capability for correct side enabling of door controls preventing the inadvertent operation of the passenger door controls.

PPP Co shall design the Driver's workstation incorporating these requirements in consultation with RailCorp. The design shall be demonstrated and agreed during the Mock-up review.

All other wiring, equipment space allocation or equipment necessary for conversion to Driver only operation shall be provided. This includes, but is not limited to power supplies for any additional CCTV cameras or monitors.

Conversion to Driver only operation shall not require the addition of any enclosures, conduits, junction boxes or attachments as these are to be included in the design and build of the Set.

**13.3 Spare Cables and Wiring**

The Set shall include spare wiring and cables for all signal types, which pass between all Cars. The number of spare cores provided, for single core signal cables, shall be not less than 4 cores or 10 % of the number of inter-car signals, whichever is the greater. At least two 3 core screened cables shall be provided as spares looping between all major termination points in each Car. Spare capacity shall be provided for each type of cable used, in line with this requirement, both for wiring and cables within a Car and for wiring and cables between Cars on the Set.

The requirement for spare cables shall not apply to power cables (cables greater than 1.5mm<sup>2</sup>) provided space is available within ducts, conduits and equipment cabinets to allow the future installation and termination of at least 10% additional power cables.

Spare wiring and cables shall run between major junction boxes or termination points within each Set. Spare wiring and cables shall be clearly and permanently labelled, locked and retained adjacent to the furthest terminal strip and terminated to jumper pins at the inter-car interface.

Spare fibre optic cores cables shall be clearly and permanently labelled and run with each bundle of fibre optic cables within a Car and between Cars on the Set. Termination of spare fibre optic cores cables shall be to a suitable non-proprietary, industry standard.

All spare cables and all spare fibre optic cores shall be shown within the electrical circuit schematics and harness schedules to be provided to RailCorp.

**13.4 Electrical Auxiliary Power Supply Reserve Capacity**

The Electrical Auxiliary Power Supply (EAPS) shall have a minimum power capacity of 110% of its rated load in order to provide a 10% reserve capacity to allow for future expansion.

**13.5 Miniature Circuit Breaker (MCB) Spare Capacity**

Spare space shall be provided on all Circuit Breaker panels to allow the installation and wiring of an additional 20% quantity of MCBs.

**13.6 Train Operating System Expansion**

The Train Operating System shall include provision of at least ten additional bi-directional channels for future expansion. A single channel shall be considered to be data linkable to transmit along the full length of the Set.

RFTA  
00036

## 13.7 Not used

## 13.8 Digital Train Radio Equipment (DTR)

### 13.8.1 Overview

The future replacement of the MetroNet System will require the installation of additional/new Train Radio equipment, which will most likely be built around a digital platform. At this time there are no approved candidate Systems. The Set shall be designed so that the change over to the future Train Radio System can be managed and facilitated with minimum modification to the Sets. It is currently considered that it will not be possible to change over Train Radio Systems in a single operation. Change over will most likely be by geographical area. There will therefore be a time when both Systems may have to co-exist on the Set.

### 13.8.2 Requirements

The following shall be considered and incorporated in the design of the Sets:

#### 13.8.2.1 Equipment Space

Equipment space shall be reserved so that the DTR equipment can be installed while the MetroNet equipment is still functional. The minimum space to be reserved is 10U of 19" rack accommodation. (See also requirements for ATC systems)

#### 13.8.2.2 Cable Routes

Cable routes from the DTR reserved space shall be provided to the locations necessary to access the equipment fitted for DTR and the existing MetroNet location, if this is different.

Cable routes shall also exist to the location reserved for future Automatic Train Control and over speed protection equipment. Ducts shall be of nominal 11,000 mm<sup>2</sup>.

#### 13.8.2.3 Antennas

A location shall be nominated by PPP Co on the roof for the DTR antenna. The space nominated shall enable a RF feeder to be provided, to the reserved DTR equipment location, such that the feeder loss shall not be greater than 3dB at 1900MHz. The location chosen shall take account of and shall ensure that no interaction takes place with any other antenna or equipment on the Set, including the MetroNet antenna and any Global Positioning Satellite (GPS) antennas fitted.

A second location shall be nominated on the roof for a second DTR antenna. The location and technical requirements shall comply with those for the first antenna, except that the antenna feeder route will be permitted to have a loss no greater than 6 dB at 1900 MHz. The position chosen shall be such that interaction with other antennas is minimised and does not create degradation of the Systems served by those antennas.

#### 13.8.2.4 Transponder Reader equipment

It is most likely that either the DTR system itself, or a future train control system, will require an upgrade of the transponder reader and under train antenna. The new equipment will most likely be similar to the Eurobalise system, developed for the European Train Control System. The cable routes to the MetroNet under train antenna shall be capable of containing the additional cables for the new system. For sizing this shall be considered to be a 4 pair heavy duty communications type cable.

#### 13.8.2.5 User interface

It should be assumed that the DTR shall require a new control head as a user interface. The cable routes, from the reserved DTR location, to the location chosen for the MetroNet control head, shall be large enough to accommodate an additional two heavy duty 2 pair communications cables to be installed.

#### 13.8.2.6 Power

The DTR shall be assumed to require 200 watts of power that shall be provisioned in the design for the Set.

13.8.2.7 Other Interfaces

The DTR will require access to the audio circuits for loudspeaker and handset as used for MetroNet. Cable routes to this equipment shall be provided.

The DTR will require access to the “Cab Occupied” circuit in the same manner as MetroNet.

13.8.2.8 Additional Connection Requirements

The DTR will most likely provide additional functionality to that provided by MetroNet. Some of this functionality, e.g. audio access to the train Public Address system, is already catered for, but currently not enabled, in MetroNet. The design of the Sets shall demonstrate that the following additional functions can be catered for:

- (i) Access, by data communication links, to the Set-borne Gateway for all available services.
- (ii) Access, by data communication links, to the on-train positioning system (e.g. GPS); and
- (iii) Under emergency conditions and where the Driver and Guard are unable to respond to radio messages from MetroNet control it shall be possible for the Digital Train Radio system to provide connectivity between the MetroNet control and the train borne voice and visual communication Systems.

**13.9 Future Automatic Train Protection (ATP) and Automatic Train Control (ATC)**

13.9.1 Overview

RFTA  
00227

During the life of the Sets Within the next five years RailCorp will is likely to upgrade its current signalling and control system moving towards Automatic Train Protection and Automatic Train Control systems using the European Train Control System (ETCS) level 1 system. To facilitate equipment installation the Sets require provision of suitable space, for the equipment, access to Set controls, and provision of wiring ducts and cable routes.

13.9.2 Control Interfaces

Future ATC/ATP systems will require access to the Set’s primary driving and safety controls.

The Set design shall demonstrate that the necessary interfacing methods have been provided to facilitate the connection and installation of ATC/ATP systems.

As a minimum access to traction control, Service Brake control, Emergency Brake control, speed indication, door controls, Event Recorder shall be demonstrated.

13.9.3 Human Interface

The ATC/ATP system will require access to the existing Driver interface for the purpose of advising target speed, restriction and system operation detail or alternatively the ATC/ATP system will require allocated space in the driving location to present the systems information on a separate user display.

13.9.4 Space requirements

RFTA  
00227

At this time no determination definitive supplier of ATC/ATP equipment type has been made identified. To facilitate future installation an equipment space of 12 U 24 U (19 inch rack units) shall be provided, the space may be split between two 6U areas in the area behind the Guards Side of the TDC No.2 End Vestibule. The ATC/ATP enclosure shall be fitted from build.

The ATC/ATP enclosure shall be fitted with a full height 19 inch rack frame which shall only be used to accommodate ATC/ATP, DTR equipment or other future RailCorp requirements (see also requirements for DTR systems).

### 13.9.5 Power Requirements

The ATC shall be assumed to require 600 watts of power, which should be provisioned in the base design for the Set

### 13.9.6 Access to Radio Communications

Future ATP/ATC systems may require access to the Digital Train Radio, track transponder readers and provision of additional readers or aerials to pick up information from track mounted transponder or by broadcast signals.

The design shall incorporate the necessary wiring ducts, between the locations identified for these items of equipment and the location nominated for the ATC equipment to facilitate the installation of these connections at a future date.

Wiring ducts shall be of nominal 11,000 sq mm and should be easily accessible and allow for quick installation of required new cables.

### 13.9.7 Additional bogie & underframe equipment

The ATP equipment may require the addition of equipment to the bogie.

## 13.10 Train Speed Protection Equipment

Not used.

## 13.11 Global Positioning System

There are a number of future uses where Set position may also be utilised.

- (a) Correct side door control enable – Set/track position is used in conjunction with a network map to ensure that only the doors on the platform side are enabled for opening at stations. This shall be able to be manually overridden, in case of incorrect configuration data or change of platform;
- (b) Advanced Train Control Systems - Set/track position is used to report Set position to ground based control systems;
- (c) Train overspeed protection - Set/track position is used in conjunction with a network map to ensure that line speeds are adhered to;
- (d) Reporting of Set location under emergency conditions and on command from the Rail Management Centre and the Maintenance Facility;
- (e) Ability to automatically report on on-time running to the Rail Management Centre at the completion of a timetabled run; and
- (f) Allow monitoring of Passenger load against station location.

These future uses require higher accuracy Set position information, in the order of 5m, which can not be achieved with the standard GPS equipment. Any equipment, which does not initially provide this level of accuracy, should be capable of being upgraded to meet these needs at a future date.

## 13.12 Platform Screen Door Interface

RailCorp may choose to fit platform screen doors at certain station platforms.

In this event the Set doors and the screen doors will require interlocking. The Set door shall include provision for an interface to ensure that such a device can be fitted.

**13.13 Acoustic monitoring equipment**

Provision shall be made for future fitting of acoustic monitoring equipment to the Sets to monitor the wheel/rail interface in order to assess track condition. A maximum of 5% of the Sets shall be fitted with this future provision. Space, bracketry, conduits and associated fittings shall be fitted in order to allow the future fitting of:

RFTA  
00257

- (a) two sensors per Set ~~transversely opposite each other~~;
- (b) a power supply;
- (c) a speed signal input from TOS;
- (d) a location signal input from GPS; and
- (e) a standard 19 inch electronics rack.

## APPENDIX A - DIGITAL VOICE ANNUNCIATOR AND INTERNAL DIGITAL INDICATOR OPERATION

### Change Log

Issue	Date	Author	Change
v3	CONTRACT		
v4	30/06/2009	ARJS	Addition of text changes from RFTA Group 12: 00313

## Digital Voice Annunciator and Internal Digital Indicator Operation

Message Type	Trigger / Mode					Announcement	Note #
	Single	Manual	Automatic	Remote	Station Type Trigger		
	Crew to select announcement	Crew inserts Run, announce prompt	Crew inserts Run, auto announce	Run uploaded centrally			
							<i>Common Notes: 1-4</i>
<i>DWD warning</i>	Crew Press	Crew Press	Crew Press	Crew Press	all	Please stand clear, this train is now due to depart	
<i>Standard door warning</i>	Door Close Button	Door Close Button	Door Close Button	Door Close Button	all	Stand clear, doors closing	
<i>Obstruction message after 2nd attempt</i>	Crew Select / Door obstruction	Crew Select / Door obstruction	Crew Select / Door obstruction	Crew Select / Door obstruction	when required	This train cannot depart until the doors are closed. Please stand clear, the doors will now close and lock	
<i>Pre-meditated door obstruction</i>	Crew Select / Continued Door Obstruction	Crew Select / Continued Door Obstruction	Crew Select / Continued Door Obstruction	Crew Select / Continued Door Obstruction	when required	The doors on this train have been obstructed. Would the offending passenger please remove the obstruction immediately from the doors to allow the train to depart.	
<i>Next Station</i>	Crew Select	Crew Acknowledge	Depart	Depart	all	Next stop <Station>	
<i>This Station</i>	Crew Select	Crew Acknowledge	@	@	all	<Station> station This station is <station>. This is a <destination> service. Next stop <next stop>	
<i>Approaching Station</i>	Crew Select	Crew Acknowledge	Approach	Approach	all	This train is now approaching <Station>	
<i>Change @ &lt;&gt; for &lt;lines&gt;</i>	Crew Select	Crew Acknowledge	Approach	Approach	Interchange	Change at <Station> for the <list of Lines> Line(s)	<b>5</b>
<i>Commencement</i>	Crew Select	Crew Acknowledge	Depart	Depart	Start	Good <morning/afternoon>, this train is a <Line> line service, number <Route> to <Destination>, stopping at <Stopping Pattern>	
<i>Journey</i>	Crew Select	Crew Acknowledge	Depart	Depart	Interchange	This train is on the <Line> line, number <Route> to <Destination>, stopping at <remaining Stopping Pattern>	
<i>Special</i>	Crew Select	Crew Select	Crew Select	Crew Select		Varied (configurable by Maintenance Staff within limits of voice library)	

RFTA  
00313

IDI Operation								
Message Type	Trigger / Mode						Announcement	Note #
	Single	Manual	Automatic	Remote	Station Type Trigger			
	Crew to select announcement	Crew inserts Run, announce prompt	Crew inserts Run, auto announce	Run uploaded centrally				
								<i>Common Notes: 1-3, 9, 10</i>
<i>DWD warning</i>							<Blank>	
<i>Standard door warning</i>							<Blank>	
<i>Obstruction message after 2nd attempt</i>							<Blank>	
<i>Pre-meditated door obstruction</i>							<Blank>	
<i>Next Station</i>	Crew Select	Crew Acknowledge	Depart	Depart	all	Approach	<Station> Next	
<i>This Station</i>	Crew Select	Crew Acknowledge	@	@	all	15 seconds	<Station> Station	
<i>Approaching Station</i>	Crew Select	Crew Acknowledge	Approach	Approach	all	See Note	Approaching <Station>	<b>6,8</b>
<i>Change @ &lt;&gt; for &lt;lines&gt;</i>	Crew Select	Crew Acknowledge	Approach	Approach	Interchange	See Note (10 seconds)	Change for <Lines> Lines	<b>7,8</b>
<i>Commencement</i>	Crew Select	Crew Acknowledge	Depart	Depart	Start	Scroll	<Line> Line <Route> to <Destination> stopping at <Stopping Pattern>	
<i>Journey</i>	Crew Select	Crew Acknowledge	Depart	Depart	Interchange	Scroll	<Line> Line <Route> to <Destination> stopping at <remaining Stopping Pattern>	
<i>Special</i>	Crew Select	Crew Select	Crew Select	Crew Select	See Note	Scroll	IDI only (special) messages	<b>11, 12</b>



## Additional Notes

**Note 1:** <Route> number is not currently defined or implemented in CityRail system, but will be up to 3 digit alphanumeric;

**Note 2:** The approach and depart trigger points to be Maintenance Staff configurable, initially set to 250m;

**Note 3:** Before and after the end of the platforms. The @ station trigger is to be configured as mid platform, stopped and door open button pressed;

EXCEPTIONS: Wollli Creek / Tempe – Approach trigger only  
Clyde / Granville

**Note 4:** Configurable chimes to precede all announcements

**Note 5:** The Change @ DVA message is announced following the approaching station message, before the train pulls into the station.

Change @ message is announced only outside of Peak Hours. For this purpose, Peak Hours are to be configured as:

Start:	Finish:
07.00	09.00
17.00	19.00

**Note 6:** Approaching <Station> message will scroll on IDI (1 second), flash three times (3 seconds total) and then stay on IDI for 10 seconds. Times to be configurable.

**Note 7:** Change at <Station> for <lines> IDI message will be displayed concurrently with "Approaching Station" message, and will be displayed on the bottom segment of the IDI after the approaching station message has flashed 3 times, and remain for 10 seconds.

**Note 8:** If there is an interchange with more than 3 connecting stations, the approaching station IDI message and the change @ IDI message will trigger early to allow 10 seconds of display for each station.

**Note 9:** Display and message options for IDI:

1. Next Station
2. Approaching Station
3. This Station
4. Special (TBD, Special)
5. Approaching Station, Change @
6. Next Station, Commencement
7. Next Station, Journey

**Note 10:** Nominated Display times and flashing / scrolling properties are configurable

**Note 11:** IDI special message in will scroll on the bottom segment of the IDI concurrent to the current display message.

**Note 12:** IDI special message display can be programmed for:

1. Interval of 5 or 15 minutes (time trigger mode)
2. A specified, configurable location  
(eg. Approaching a station where there is a change of service)
3. Crew selectable

## APPENDIX B – WASHPLANT FACILITIES

### 1.0 Washplant Facility Details.

CityRail operates a washplant facility at each of its three Maintenance Centres to clean the car exterior sides and part of the roof area. Details of the washplant facilities are as follows:

<b>1.1</b>	<b>GENERAL PARAMETERS:</b>	
1.1.1	Propulsion Method	Train towed or driven
1.1.2	Maximum Track Grade	1.961%
<b>1.2</b>	<b>WASH PARAMETERS:</b>	
1.2.1	Train Washing Speed	4 km/hr
1.2.2	Detergent application arch	
1.2.3	Spray Nozzle Brand	Spraying Systems Company
1.2.4	Nozzle Type/Size	H 1/4 U.S.S.4008 (Note 1)
1.2.5	Nozzle angle	40 degree V – jet
1.2.6	Nozzle flow	4 to 5 litres per minute
1.2.7	Nozzle quantity	9 per side (Total 18)
1.2.8	Spray Pressure	7 bar (100 psi)
1.2.9	Brush Diameter	833 mm (3 off each side)
1.2.10	Brush Material	Polypropylene
1.2.11	Detergent Active ingredient	Oxalic Acid
1.2.12	Detergent Supplier	Applied Chemicals No. 2-544
1.2.13	Concentration Target	(Note 2)
<b>1.3</b>	<b>RINSE PARAMETERS:</b>	
1.3.1	Train Rinsing Speed	4km/hr
1.3.2	Spray Nozzle Brand	Spraying Systems Company
1.3.3	Nozzle Type/Size	H 1/4 U.S.S.5030 to H 1/4 U.S.S.5050 (Note 3)
1.3.4	Nozzle angle	40 degrees
1.3.5	Nozzle flow (total arch)	1250 to 1600 litres per minute
1.3.6	Nozzle quantity	26 per side (Total 52)
1.3.7	Spray Pressure	7 bar (100 psi)
1.3.8	Rinse agent	Fresh tap water (Note 4)
<b>1.4</b>	<b>FOAM ACID APPLICATION</b>	
1.4.1	Nozzle angle	80 degree V - Jet
1.4.2	Operating pressure	25 to 30 psi
1.4.3	Flow to foam arch	30 to 40 litres/min

## 2.0 Additional Notes

- Note 1: The detergent arches are no longer in use. The application of detergent is via the foam arch where:
- Nozzle Quantity is 9 per side,
  - Nozzle type Bex K Ball F80.10.
- Note 2: The active ingredient, Oxalic Acid is supplied as 20% of total Train wash solution in its raw form. The active ingredient Oxalic Acid is further reduce by dilution when it enters the Acid blend tank prior to delivery to the train. The active ingredient Oxalic Acid is controlled at 1% (+or- 0.5%) on application to the train.
- Note 3: The nozzles used in the washplant provide a uniform coverage of detergent and rinse water over the exterior sides and roof of a double deck railcar.
- Note 4: Recycled water is also returned from the rinse cycle tank and sprayed onto the 6 scrub brushes when in use. Rinse water is maintained at 7pH.

## APPENDIX C – ROUTES AND TIMINGS

### Double Deck

#### 1.0 Hornsby - Central - Hornsby

Run Number	H1	H2
Rate of acceleration (m/s <sup>2</sup> )	0.8	1
AW3 Loading		

	PLACE NAME	LOCATION	STAND	LENGTH	TIME	TIME
			TIME			
		KM	M: S	KM	M: S	M: S
DEP	HORNSBY	25.17				
ARR	WAITARA	24.13		1.04	3:10	3:09
			0:30			
DEP	WAITARA	24.13				
ARR	WAHROONGA	22.69		1.44	1:47	1:45
			0:30			
DEP	WAHROONGA	22.69				
ARR	WARRAWEE	21.81		0.88	1:25	1:22
			0:30			
DEP	WARRAWEE	21.81				
ARR	TURRAMURRA	20.7		1.11	1:27	1:26
			0:30			
DEP	TURRAMURRA	20.7				
ARR	PYMBLE	18.82		1.88	2:04	2:02
			0:30			
DEP	PYMBLE	18.82				
ARR	GORDON	17.04		1.78	2:01	2:00
			0:30			
DEP	GORDON	17.04				
ARR	KILLARA	15.81		1.23	1:35	1:33
			0:30			
DEP	KILLARA	15.81				
ARR	LINDFIELD	14.51		1.3	1:37	1:36
			0:30			
DEP	LINDFIELD	14.51				
ARR	ROSEVILLE	13.19		1.32	1:50	1:49
			0:30			
DEP	ROSEVILLE	13.19				
ARR	CHATSWOOD	11.57		1.62	1:56	1:54
			1:00			
DEP	CHATSWOOD	11.57				
ARR	ARTARMON	10.22		1.35	1:44	1:43
			0:30			
DEP	ARTARMON	10.22				
ARR	ST. LEONARDS	8.33		1.89	2:01	1:59
			0:30			
DEP	ST. LEONARDS	8.33				
ARR	WOLLSTONECRAFT	7.1		1.23	1:58	1:57
			0:30			
DEP	WOLLSTONECRAFT	7.1				
ARR	WAVERTON	6.03		1.07	1:56	1:58

	PLACE NAME	LOCATION	STAND	LENGTH	TIME	TIME
			TIME			
		KM	M: S	KM	M: S	M: S
			0:30			
DEP	WAVERTON	6.03				
ARR	NTH. SYDNEY	5.05		0.98	4:23	4:21
			1:00			
DEP	NTH. SYDNEY	5.05				
ARR	MILSONS POINT	4.36		0.69	1:21	1:20
			0:30			
DEP	MILSONS POINT	4.36				
ARR	WYNYARD	1.97		2.39	3:48	3:45
			1:00			
DEP	WYNYARD	1.97				
ARR	TOWNHALL	1.1		0.87	1:33	1:32
			1:00			
DEP	TOWNHALL	1.1				
ARR	CENTRAL #18	0.17		1.27	2:26	2:25
	TOTALS	TIME			0:51:09	0:50:45
DEP	CENTRAL #18	0.17				
ARR	REDFERN	1.38		1.21	1:41	1:40
			0:30			
DEP	REDFERN	1.38				
PASS	ASHFIELD	8.46		7.08	9:00	8:58
ARR	STRATHFIELD	11.89		3.43	3:07	3:07
			1:00			
DEP	STRATHFIELD	11.89				
ARR	NTH STRATHFIELD	13.46		1.65	2:32	2:31
			0:30			
DEP	NTH STRATHFIELD	13.46				
ARR	CONCORD WEST	14.62		1.16	1:34	1:33
			0:30			
DEP	CONCORD WEST	14.62				
ARR	RHODES	16.66		2.04	2:17	2:15
			0:30			
DEP	RHODES	16.66				
ARR	MEADOWBANK	18.26		1.6	1:58	1:56
			0:30			
DEP	MEADOWBANK	18.26				
ARR	WEST RYDE	19.28		1.02	1:25	1:23
			0:30			
DEP	WEST RYDE	19.28				
ARR	DENISTONE	20.24		0.96	1:26	1:24
			0:30			
DEP	DENISTONE	20.24				
ARR	EASTWOOD	21.47		1.23	1:47	1:43
			0:30			
DEP	EASTWOOD	21.47				
ARR	EPPING	23.47		2	2:21	2:18
			0:30			
DEP	EPPING	23.47				
ARR	CHELTENHAM	25.44		1.97	2:18	2:17
			0:30			

	PLACE NAME	LOCATION	STAND	LENGTH	TIME	TIME
			TIME			
		KM	M: S	KM	M: S	M: S
DEP	CHELTENHAM	25.44				
ARR	BEECROFT	26.98		1.54	2:01	1:56
			0:30			
DEP	BEECROFT	26.98				
ARR	PENNANT HILLS	28.66		1.68	2:11	2:07
			0:30			
DEP	PENNANT HILLS	28.66				
ARR	THORNLEIGH	29.51		0.85	1:17	1:15
			0:30			
DEP	THORNLEIGH	29.51				
ARR	NORMANHURST	31.8		2.29	2:43	2:41
			0:30			
DEP	NORMANHURST	31.8				
ARR	HORNSBY	33.94		2.14	2:24	2:22
	TOTALS	TIME			0:50:11	0:49:33

## 2.0 Bondi Junction - Waterfall - Bondi Junction

Run Number  
Rate of acceleration (m/s<sup>2</sup>)  
AW3 Loading

B1  
0.8  
B2  
1

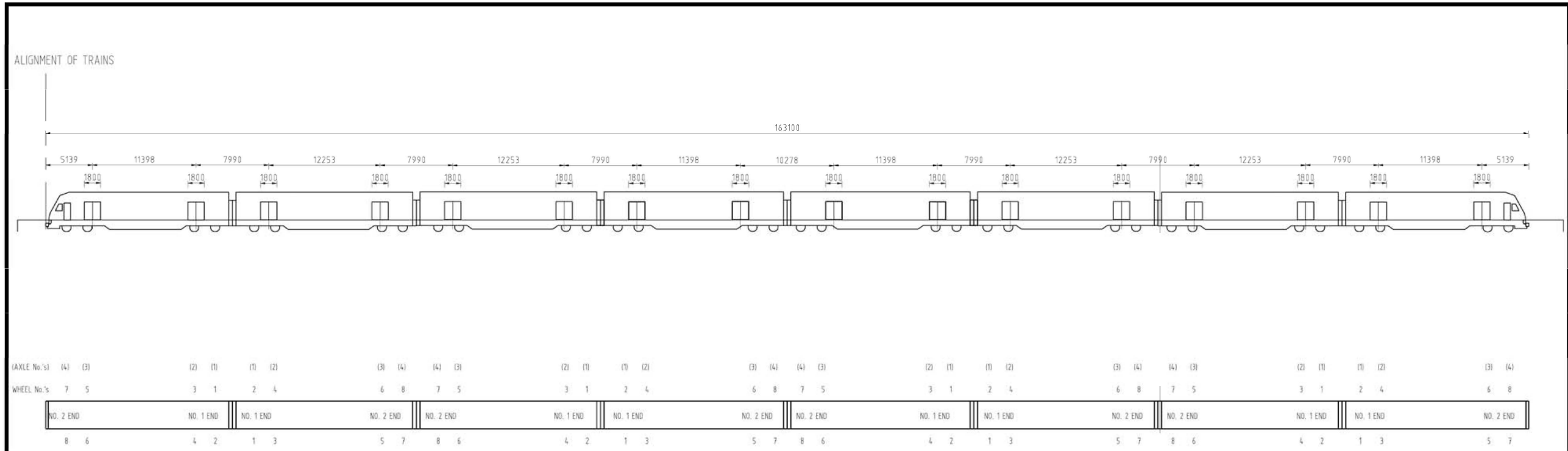
	PLACE NAME	LOCATION	STAND	LENGTH	TIME	TIME
			TIME			
		KM	M: S	KM	M:S	M:S
DEP	BONDI JUNCTION	6.71				
ARR	EDGECLIFFE	4.74		1.97	02:30	02:29
			00:30			
DEP	EDGECLIFFE	4.74				
ARR	KINGS CROSS	3.33		1.41	02:12	02:10
			01:00			
DEP	KINGS CROSS	3.33				
ARR	MARTIN PLACE	1.97		1.3	01:48	01:46
			00:42			
DEP	MARTIN PLACE	1.97				
ARR	TOWN HALL	1.12		0.85	01:24	01:22
			01:00			
DEP	TOWN HALL	1.12				
ARR	CENTRAL #25	0.18		1.28	01:54	01:52
			01:00			
DEP	CENTRAL #25	0.18				
ARR	REDFERN	1.4		1.22	02:00	01:58
			00:30			
DEP	REDFERN	1.4				
PASS	ERSKINEVILLE	2.9		1.5	02:48	02:47
PASS	ST PETER'S	3.8		0.9	01:00	01:00
ARR	SYDENHAM	5.39		1.59	01:42	01:41
			00:30			
DEP	SYDENHAM	5.39				
PASS	TEMPE	6.9		1.51	01:42	01:40
ARR	WOLLI CREEK	7.3		0.4	00:48	00:48
			00:30			
DEP	WOLLI CREEK	7.3				
PASS	ARNCLIFFE	8.5		1.2	01:18	01:17
PASS	BANKSIA	9.66		1.16	01:00	00:59
ARR	ROCKDALE	10.4		0.74	00:48	00:48
			00:42			
DEP	ROCKDALE	10.4				
ARR	KOGARAH	11.67		2.01	01:30	01:29
			00:42			
DEP	KOGARAH	11.67				
PASS	CARLTON	12.7		1.03	01:24	01:24
PASS	ALLAWAH	13.78		1.08	01:54	01:54
ARR	HURSTVILLE	14.9		1.12	01:12	01:12
			01:00			
DEP	HURSTVILLE	14.9				
ARR	PENSHURST	16.21		1.31	01:42	01:40
			00:30			

	PLACE NAME	LOCATION	STAND	LENGTH	TIME	TIME
			TIME			
		KM	M: S	KM	M:S	M:S
DEP	PENSHURST	16.21				
ARR	MORTDALE	17.13		0.92	01:48	01:46
			00:30			
DEP	MORTDALE	17.13				
ARR	OATLEY	18.36		1.23	01:42	01:41
			00:30			
DEP	OATLEY	18.36				
ARR	COMO	21.32		2.96	02:48	02:46
			00:30			
DEP	COMO	21.32				
ARR	JANNALI	22.82		1.5	02:00	01:56
			00:30			
DEP	JANNALI	22.82				
ARR	SUTHERLAND	24.74		1.92	02:30	02:26
			01:00			
DEP	SUTHERLAND	24.74				
ARR	LOFTUS	26.34		1.6	01:48	01:46
			00:30			
DEP	LOFTUS	26.34				
ARR	ENGADINE	30.85		4.51	04:24	04:18
			00:30			
DEP	ENGADINE	30.85				
ARR	HEATHCOTE	33.25		2.4	02:30	02:27
			00:30			
DEP	HEATHCOTE	33.25				
ARR	WATERFALL	38.8		5.55	05:18	05:13
	TOTALS	TIME			1:08:30	1:07:41
DEP	WATERFALL	38.63				
ARR	HEATHCOTE	33.09		5.54	04:30	04:27
			00:30			
DEP	HEATHCOTE	33.09				
ARR	ENGADINE	30.69		2.4	02:30	02:28
			00:30			
DEP	ENGADINE	30.69				
ARR	LOFTUS	26.22		4.47	04:42	04:39
			00:30			
DEP	LOFTUS	26.22				
ARR	SUTHERLAND	24.58		1.64	01:48	01:46
			01:00			
DEP	SUTHERLAND	24.58				
ARR	JANNALI	22.66		1.92	02:06	02:04
			00:30			
DEP	JANNALI	22.66				
ARR	COMO	21.18		1.48	01:54	01:52
			00:30			
DEP	COMO	21.18				
ARR	OATLEY	18.2		2.98	02:48	02:46
			00:30			
DEP	OATLEY	18.2				



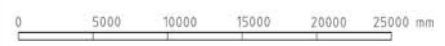
	PLACE NAME	LOCATION	STAND	LENGTH	TIME	TIME
			TIME			
		KM	M: S	KM	M:S	M:S
ARR	MORTDALE	16.98		1.22	01:42	01:39
			00:30			
DEP	MORTDALE	16.98				
ARR	PENSHURST	16.05		0.93	01:18	01:15
			00:30			
DEP	PENSHURST	16.05				
ARR	HURSTVILLE	14.78		1.27	01:48	01:46
			00:54			
DEP	HURSTVILLE	14.78				
PASS	ALLAWAH	13.61		1.17	01:36	01:34
PASS	CARLTON	12.65		0.96	00:42	00:42
ARR	KOGARAH	11.51		1.14	01:06	01:06
			00:42			
DEP	KOGARAH	11.51				
ARR	ROCKDALE	10.33		1.18	01:30	01:30
			00:42			
DEP	ROCKDALE	10.33				
PASS	BANKSIA	9.5		0.83	01:00	01:00
PASS	ARNCLIFFE	8.34		1.16	00:54	00:54
ARR	WOLLI CREEK	7.3		1.04	01:24	01:23
			00:30			
DEP	WOLLI CREEK	7.3				
PASS	TEMPE	6.74		0.56	00:36	00:36
ARR	SYDENHAM	5.24		1.5	03:18	03:16
			00:30			
DEP	SYDENHAM	5.24				
PASS	ST PETER'S	3.8		1.44	01:36	01:35
PASS	ERSKINEVILLE	2.9		0.9	00:42	00:42
ARR	REDFERN	1.24		1.66	03:12	03:11
			00:30			
DEP	REDFERN	1.24				
ARR	CENTRAL #24	0.02		1.22	01:42	01:41
			01:00			
DEP	CENTRAL #24	0.02				
ARR	TOWN HALL	1.3		1.32	01:48	01:48
			01:00			
DEP	TOWN HALL	1.3				
ARR	MARTIN PLACE	2.18		0.88	02:00	01:58
			00:42			
DEP	MARTIN PLACE	2.18				
ARR	KINGS CROSS	3.49		1.31	01:48	01:46
			00:42			
DEP	KINGS CROSS	3.49				
ARR	EDGECLIFFE	4.9		1.41	01:48	01:47
			00:30			
DEP	EDGECLIFFE	4.9				
ARR	BONDI JUNCTION	6.85		1.95	02:42	02:40
	TOTALS	TIME			1:07:12	1:06:33

## APPENDIX D (DOUBLE DECK) – DOOR POSITIONS AND AXLE NUMBERS



**DIAGRAM OF WHEEL AXLE, CAR, DOOR NUMBERING**

- NOTES**
- 1, TOLERANCE FOR THE DOOR DISTANCE  $\pm 200$  (NON CUMULATIVE) IS PREFERRED AND A MAXIMUM  $\pm 500$  (NON CUMULATIVE) MUST BE ACHIEVED.
  - 2, DUPLICATED EQUIPMENT SHALL BE SEQUENTIALLY NUMBERED FROM THE NO.1 END OF EACH CAR, EG AXLES.
  - 3, DUPLICATED EQUIPMENT LOCATED ON BOTH SIDES OF A CAR SHALL BE NUMBERED AS SHOWN EG WHEELS AND DOORS.



RAILCORP NEW ROLLINGSTOCK  
 PPP TRAIN  
 DRAFT - 24/06/05  
 Drawn By; NW Checked By: GD

## APPENDIX E – FINITE ELEMENT AND FATIGUE LIFE ANALYSES

### Change Log

Issue	Date	Author	Change
v2	CONTRACT		
v3	29/09/2008	CJEH	Addition of text changes from RFTA 00001 (RFTA Group 1)
v4	08/04/2009	ARJS	Addition of text changes from RFTA 00124 (RFTA Group 10)

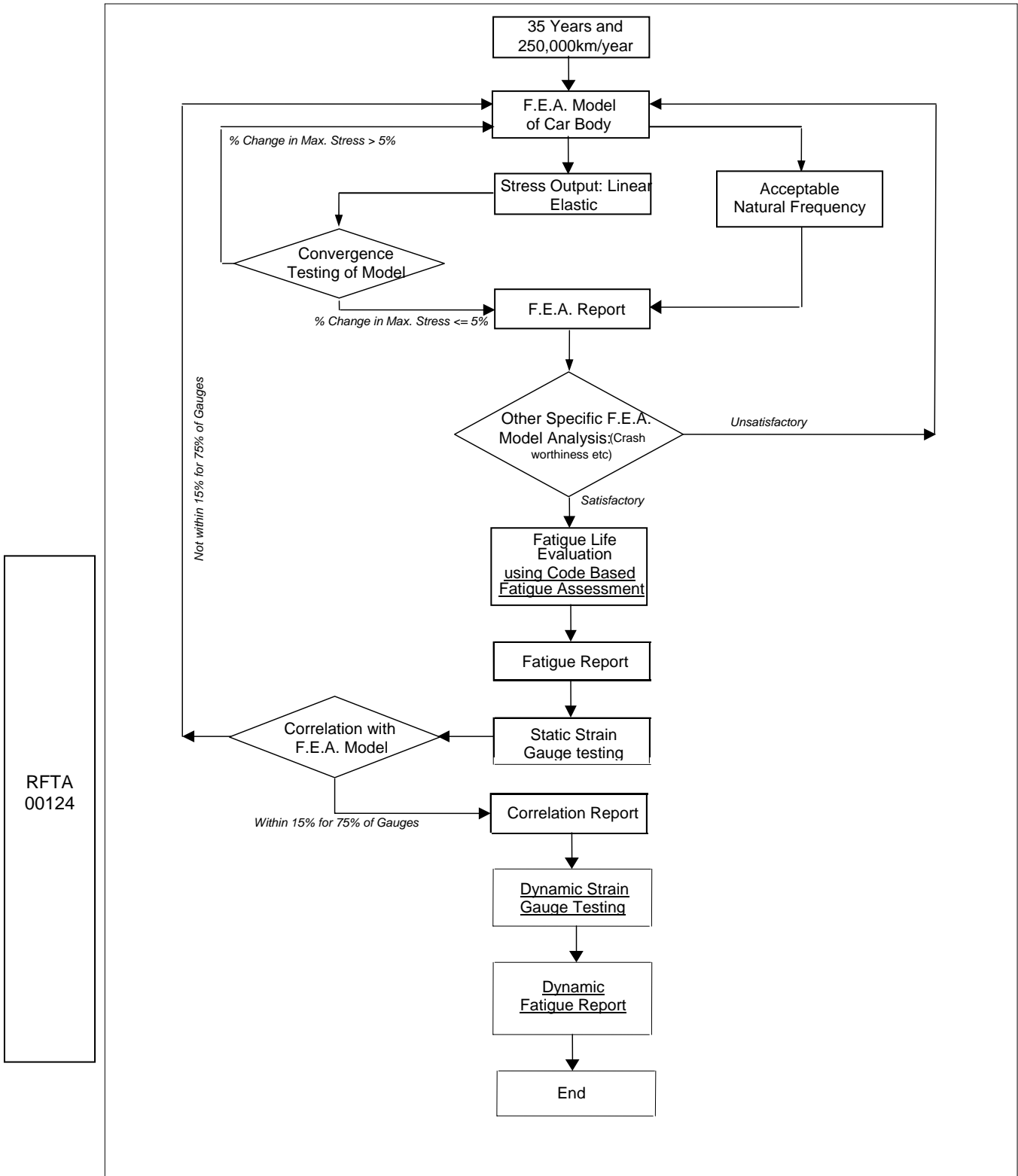
1. For the component to be analysed, a computer-based Finite Element Analysis (FEA) would be expected to use beam, plate, brick, spring and contact elements where appropriate to accurately model the physical structure of the component and appropriately model details such as welds.
2. For all FEA software used in design analysis, benchmarking information shall be provided. The software used would be expected to be commercially available and verified through industry use in product design and manufacturing.
3. For each component analysed, a FEA Report shall contain data to fully define the model used for analysis.
4. The FEA report shall include model definition data, such as:
  - 4.1. Solution options;
  - 4.2. Units definition;
  - 4.3. Material property tables;
  - 4.4. Element properties for the types of elements used (ie beam, plate, brick etc);
  - 4.5. Load case data (including static and fatigue testing);
  - 4.6. Load combination data (including static and fatigue testing);
  - 4.7. Details of any physical constraints placed on the model;
  - 4.8. General solution data;
  - 4.9. Process warning reports (including an explanation of the warnings and their implications on the solution); and
  - 4.10. Details of all assumptions made.
5. The FEA report shall include calculations for the following:-
  - 5.1. Beam element properties;
  - 5.2. Equivalent nodal loads;
  - 5.3. Pressure loads: normal;
  - 5.4. Tangential (forces); and
  - 5.5. Inertia reactions.
6. The report shall contain details of the method used and results obtained in order to verify the accuracy of the FEA software model. This would be expected to use calculations, using engineering equations in a manual checking area of the model, or actual physical testing to verify model stresses due to various loading conditions.
7. For the car bogies FEA the models would be expected to include inputs for suspension loads, track input, thermal (braking) input, torsional loads and extra loads that may be expected, such as from wheel damage.
8. The report shall include full isometric plots of the mesh used, covering:
  - 8.1. Plot of elements;
  - 8.2. Plot of elements, loads and constrained nodes;
  - 8.3. Plot of critical areas where high stresses are expected, such as corners, brackets, and holes; and

- 8.4. Details of any internal features, such as internal webs or additional internal strengthening.
9. The report shall contain a comparison of calculated loads and the summation of all loads case/combination nodal reactions (ie sum of model global forces and moments).
  10. The report shall contain deformed shape plots of the whole model at an appropriate exaggeration factor.
  11. Convergence testing shall be carried out in high stress areas to confirm model accuracy.
  12. Evidence of convergence testing shall be provided. [Note: The model would be expected to have converged if maximum stress difference is less than or equal to 5% between convergence iterations].
  13. All stress contour plots shall identify the stress concentrations and the levels of stress at the location.
  14. Stress concentrations shall not be obscured by other elements and contours shall be generated for all elements and nodes. Masking is not permitted, unless agreed that the area is unimportant.
  15. All stress concentrations shall be identified and any critical areas would be expected to be modelled in greater detail.
  16. Information provided on stress analysis regions shall be in addition to all other information requested.
  17. The report shall contain the following full model stress contour plots. Plots are to be isometric with top and bottom fibre surfaces identified. Plots are to be A4 minimum.
    - 17.1. Von Mises stresses for maximum of top or bottom fibre: all load cases/combinations analysed.
    - 17.2. Detailed stress contour plots shall be provided for areas to be analysed for fatigue.
    - 17.3. Von Mises stresses: all load cases/combinations analysed.
    - 17.4. Major and minor principal stresses: all load cases/combinations analysed.
  18. Apart from linear elastic analysis, other analysis requirements, due to the nature of the car body structure, shall include:-
    - 18.1. Non-linear elastic analysis (to be confirmed prior to the CDR);
    - 18.2. Buckling, including non-linear geometry;
    - 18.3. Crash worthiness; and
    - 18.4. Either FEA Simulation or physical testing of missile penetration including material failure.
  19. The FEA analysis for car bodies shall follow the procedure shown in Figure 1.
  20. The FEA analysis for car bogies including the static test for correlation purposes shall follow the procedure shown in Figure 2.
  21. The PPP Co shall conduct the bogie life testing to UIC 615 - 4 or equivalent. If the bogie fails as a result of this test the PPP Co shall submit a proposal and undertake the process as described in Figure 2 as appropriate.
  22. The PPP Co may wish to consider carrying out non-destructive testing of weld regions, especially on the first production products, to verify their integrity.

RFTA 00001
---------------

**FIGURE 1.**

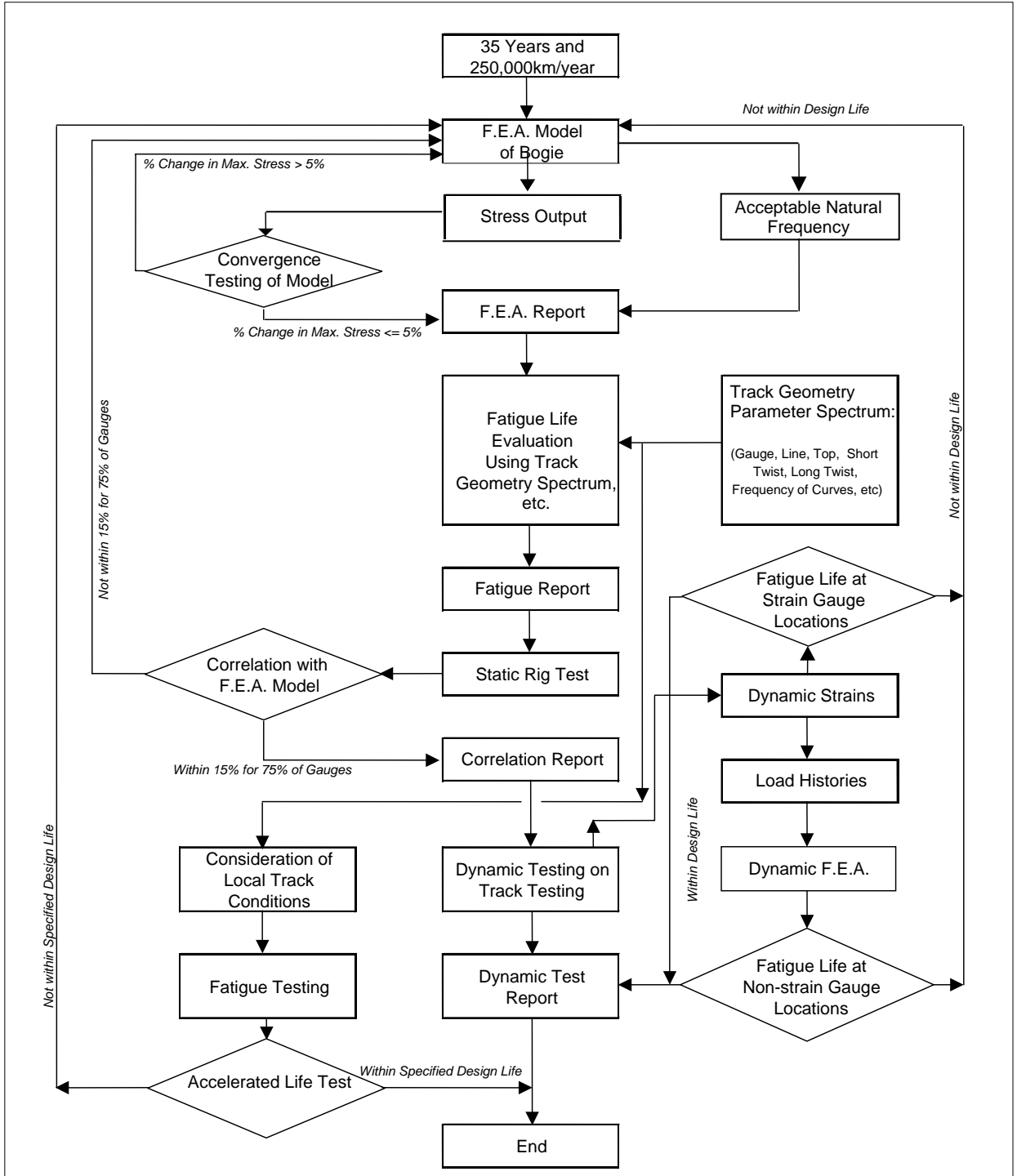
**CAR BODY – DESIGN AND TEST PROCEDURE FOR STRUCTURE AND FATIGUE**



RFTA  
00124

**FIGURE 2.**

**CAR BOGIES – DESIGN AND TEST PROCEDURE FOR STRUCTURE AND FATIGUE**



## APPENDIX F – RIDE QUALITY

### Requirements & Testing, including Kinematic Rolling Stock Outline

#### Change Log

Issue	Date	Author	Change
v2	CONTRACT		
v3	30/09/08	CJEH	Addition of text changes from RFTA00138 (RFTA Group 1)



## 1.0 General

Ride quality shall be measured over extended running of at least 200 km throughout the operating environment at speeds corresponding up to 110 per cent of the design operating speed, unless otherwise specified, and as applicable to the Set's operating condition (with respect to air spring condition, if supplied). This running would be compiled from such runs as follows: Berowra to Penrith via the North Shore (~92 km); Berowra to Berowra via the North Shore and Main North (~81 km); Penrith to Campbelltown via Harris Park Y Link (~67 km); Campbelltown to Central via East Hills Circular Quay (~52 km) or via Granville (~55 km); Bankstown to Circular Quay loop (~51 km) all in either direction, with no duplication of runs.

Testing may be performed at the discretion of RailCorp on any or all track locations within the operating environment.

Unless otherwise specified, testing shall be performed in both the tare and crush loaded conditions. For the latter, the Cars shall be weighted to simulate passenger crush loading, including the centre of gravity.

Testing shall be performed with the Set in the new condition with the suspension in the normal condition unless otherwise specified, and at the service limits nominated by PPP Co and agreed by RailCorp, for the bogie and any other running gear without exceeding the criteria below.

The design and the agreed maintenance scope and frequency shall ensure that the required performance is achieved at all times.

The ride quality of the Set, as measured by the criteria described below, shall be equivalent to or better than the Millennium Trains as follows: overall for each run, the value of each parameter measured on each Set shall be better than the value of the corresponding selected parameter for the selected position of the selected Millennium Trains when back-to-back testing is performed at speeds corresponding to up to 110mm Superelevation deficiency up to and including maximum design speed (unless otherwise specified). Values for the various criteria are provided only as a guide to the performance of the Millennium Trains.

The ride quality criteria shall be reported overall for each run, for major sections of track length (eg. Central to Hornsby), and where appropriate (such as for Ride Index) continuously over short sections of track. PPP Co shall provide any further data requested by RailCorp.

The criteria used to evaluate ride quality are derived from:

- a) accelerations measured in the three mutually perpendicular directions: vertical, lateral and longitudinal, at the nominated locations;
- b) body roll angle;
- c) suspension displacements;
- d) time; and
- e) distance and/or location.

The acceleration data shall be filtered according to the specified criteria. Filter attenuation rates shall be a minimum of 24 dB/octave, unless otherwise specified.

The Jerk values shall be derived from accelerometer output.

The acceleration and ride values in this Appendix were obtained from the Millennium Train ride test performed on 7 September 2002 and are provided to assist in the design of the Set.

## 2.0 Maximum Accelerations and Jerk

Acceleration data for the extended running shall be filtered at 20 Hz low pass for determining maximum acceleration, and approximately 5 Hz low pass for Jerk.

Longitudinal acceleration shall also be high pass filtered at approximately 0.5 Hz to remove normal train handling and gradient influences.

The measurements shall be made on the floor above bogie centres and in the upper Saloon on the floor and/or seating level. Measurements shall be made over the trailing bogie centre of the Set. Measurements may also be taken on the ceiling of the upper Saloon or on the ceiling above bogie centres.

The following values apply to measurements taken on the Car floor above bogie centres, including the trailing bogie. Values have not been included for deflated air springs, but testing shall be performed.

Criteria (Absolute value)	Normal suspension condition		
	Direction (Orientation)		
	Vertical	Lateral	Longitudinal
Maximum acceleration, peak (g)	0.26	0.22	0.025
Maximum Jerk, peak (g/s)	Same as M-set car		

## 3.0 Acceleration Histograms

Acceleration data for the extended running, filtered at 20 Hz low pass and additionally at 0.5 Hz high pass for Lateral acceleration shall be used for the acceleration histograms. The histograms shall be based on zero-crossing analysis. The class intervals for the acceleration levels shall not exceed 0.05g. The two-sided (positive and negative) zero-crossing output of Lateral acceleration shall be checked for instrumentation offset and corrected if required.

The following maximum values (Figure 9d) are provided and relate to the suspension in the normal operating condition. For deflated airsprings, the limit shall be that of the end of the Millennium Train nominated by RailCorp.

### 4.0 Acceleration versus Speed Histograms (National Vehicle Acceptance Standard)

An analysis, which outputs two-sided (positive and negative) histograms of acceleration (peaks and averages) versus speed, shall also be performed for the extended running. The averages are separately, the arithmetic mean of the positive peaks and, the arithmetic mean of the negative peaks. The acceleration data shall be bandpass filtered between 0.1 and 20 Hz. The class intervals shall not exceed 5km/h for speed and 0.05g for acceleration. The table below provides maximum values relating to the suspension in the normal operating condition.

Parameter	Vertical limits	Lateral limits
Maximum acceleration, peak (g)	+/- 0.26	+/- 0.22
Average (mean peak) acceleration (g)	+/- 0.029	+/- 0.024

## 5.0 Jerk Histograms

Jerk histograms shall be used, as a criterion for comparison of the ride of the Set and the selected Millennium Train set / end, using the accelerations from the extended running filtered at approximately 5 Hz low pass.

## 6.0 Kinematic Rolling Stock Outline

The theoretical maximum Kinematic Rolling Stock Outline of each Car type under the stated operating conditions, including the calculations and assumptions, shall be provided by PPP

RFTA 00138
---------------

Co prior to System Definition Review during the design reviews conducted in accordance with the CMR Attachment 4 - Section 4.5.

The actual Kinematic Rolling Stock Outline of the Set shall be determined by measuring the maximum roll angle relative to the track plane and the maximum Lateral and vertical displacements of the suspension system. The individual maximums shall be combined with the roll centres for the suspension elements, the bogie centres, and the Car body and pantograph outlines to determine the Kinematic Rolling Stock Outline of each Car type for the tare and crush loaded conditions. Testing shall be performed through curves with the Set operating at the Superelevation deficiency nominated in RSU 289, excluding the transient roll effects. For the purposes of this test all vertical suspension points on the Car shall be measured to obtain the average angular displacement of the Car with respect to the rail plane. This is to mitigate the influence of transient track irregularities.

The Cars shall remain within the Kinematic Rolling Stock Outline at all times under all conditions of loading, dynamic behaviour and wear, when tested at the Superelevation deficiency nominated in RSU 289.

The crush loaded Set shall remain within the kinematic rolling stock outline under all conditions of wear nominated by PPP Co to the satisfaction of RailCorp when body roll and Lateral displacements are measured with the Set standing on the Superelevation nominated in RSU 289.

#### **7.0 Car body Roll and Sway Frequencies**

The roll and sway frequency shall be such that they do not cause a feeling of motion sickness to the passengers and crew. The roll and sway frequencies shall be determined from lateral accelerations and displacements.

## 8.0 Ride Index

The ride index of the Set shall be equal to or better than a Millennium Train when tested in a back-to-back situation under the conditions described in Section 1. This shall be achieved up to any track speed that corresponds to 110 mm Superelevation deficiency and up to the maximum service speed of the Set over any track complying with the minimum standard.

### 8.1 Method Overview

The acceleration data is subjected to a Fast Fourier Transform (FFT) analysis over the required frequency range. An intermediate value,  $V_i$ , based on the frequency-weighted peak acceleration levels derived from the FFT, is then calculated for each line of the FFT. A ride index ( $RI_i$ ) is then calculated for each intermediate value. These are then combined to give the overall ride index value ( $RI_{total}$ , or just RI).

### 8.2 Details

The FFT frequency analysis shall be a minimum of 400 lines of equal bandwidth covering the frequency range of 0-100 Hz with a minimum resolution of 0.25 Hz. A minimum of 16 averages shall be used, but 32 is preferred to minimise statistical error.

The intermediate values,  $V_i$  shall be calculated for each line of the FFT according to the appropriate frequency-dependent formula, according to the following table. The formulae include frequency and peak acceleration components

ie.  $V_i = \text{function}(F, A)$ .

Table of Weightings for Calculation of  $V_i$ .

Frequency (Hz)	Vertical	Lateral
0 - 6	$0.325 FA^3$	$4.32 A^3$
6 - 20	$400 A^3/F^3$	$650 A^3/F^3$
20 - 50	$A^3/F$	$A^3/F$

where  $F = \text{Frequency (Hz)}$

$A = \text{Amplitude, peak (g)}$

The ride index for each line,  $RI_i$  is calculated using:

$$RI_i = 7.07(V_i)^{0.1}$$

Over the frequency range from 0.5 Hz to 50 Hz inclusive, the overall ride index shall be calculated using the following summation of the i-th values of  $RI_i$  :

$$RI_{total} = \left[ \sum_{i=1}^n (RI_i)^{10} \right]^{0.1}$$

## 9.0 Millennium Ride Information

The following is the Millennium car ride information for guidance for the back-to-back testing. Note that for gathering this information, the Millennium cars were only operated up to a maximum of 110 mm Superelevation deficiency.

Attached are:

- (a) RI values measure on the floor above bogie centre;
- (b) Cumulative Distance (speed vs Distance);
- (c) Acceleration verses Speed histograms (NVAAS); and
- (d) Acceleration histograms, prior to any instrumentation offset correction, for the complete journey (Sydney Terminal – Strathfield – Berowra –Homebush Goods – Penrith – Sydney Terminal).

## 10.0 Millennium Train General Information

Train sets targeted and referred to as Millennium Train or 'M' Sets consist of 2 Double Deck Suburban Motor Cars and 2 Double Deck Suburban Trailer-Control Cars.

These Cars operate as four-car and eight-car trains on the CityRail electrified system.

The nominal dimensions and masses of the different car types are as follows.

	<b>Motor Car</b>	<b>Trailer-Control Car</b>
Coupled Length (mm)	20,243	20,532
Over Body Length (mm)	19,487	19,776
(excl. anticlimbers and gangway bellows)	(between collision posts)	(incl. cab canopy)
Bogie Centres (mm)	13,945	13,945
Bogie Wheel Base (mm)	2,300	2,300
Wheel Diameter (new)	940	940
Vehicle Tare Mass Complete with Bogies (Tonnes)	53 to 55	49 to 51

The bogies are bolster-less type, with a rigid one-piece fabricated H-shaped frame. The trailer and motor bogies use a common frame design with two frame hung traction motors fitted to each motor Car bogie.

The primary suspension is of the winged axlebox type incorporating bonded rubber/metal conical springs.

The secondary suspension consists of a single air spring per bogie fitted centrally between the bogie frame and the Car underframe/body. An anti-roll bar is also fitted to each bogie to maintain the Car body in the upright position and contain body roll.

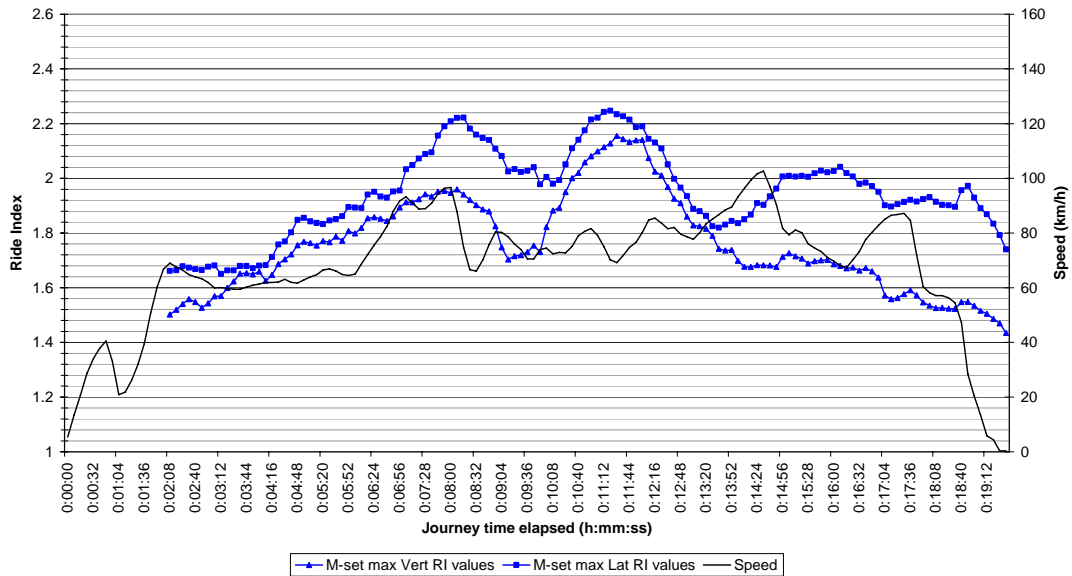
Levelling valves are fitted to each bogie to control the vehicle height for various passenger loadings.

All bogies are fitted with wheel mounted disc brakes.

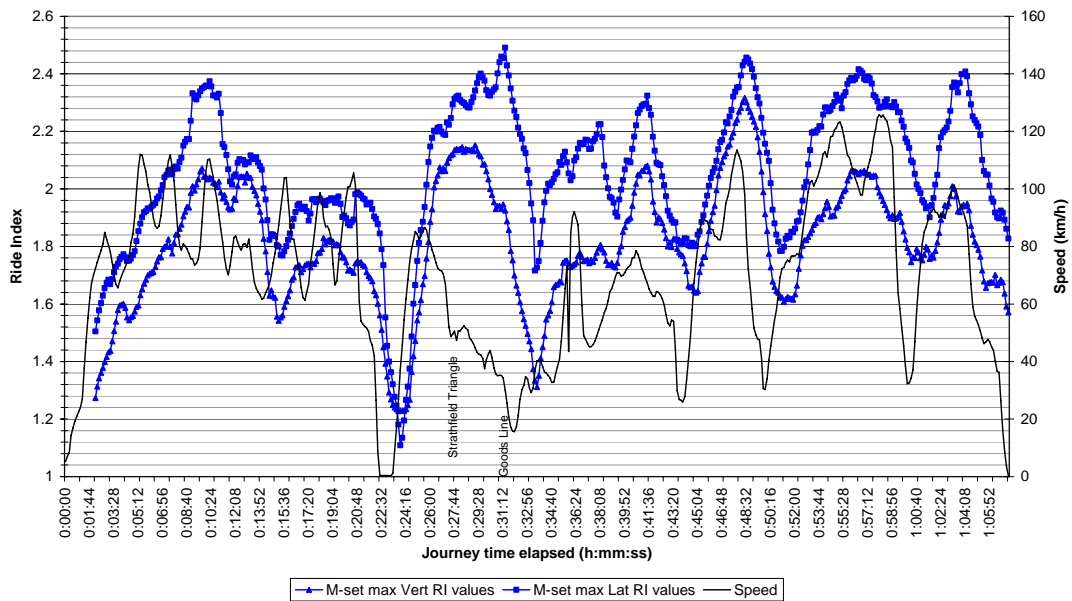
Attachment

9a) RI values measured on the floor above bogie centre

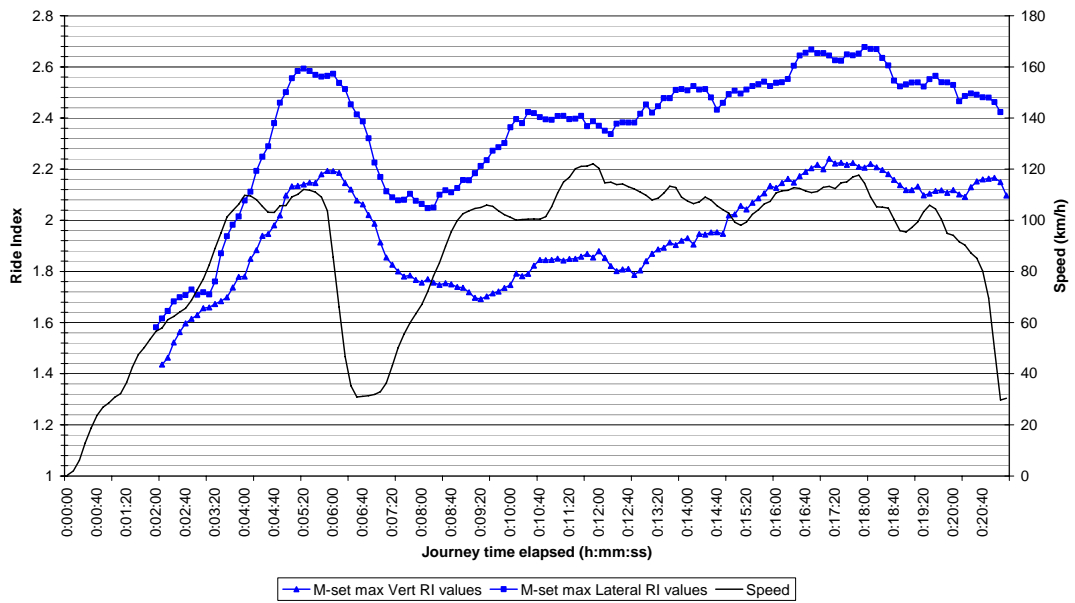
M Set Ride Test - Epping to Berowra on 7 September 2002



M Set Ride Test - Berowra to Penrith via Homebush Goods on 7 September 2002



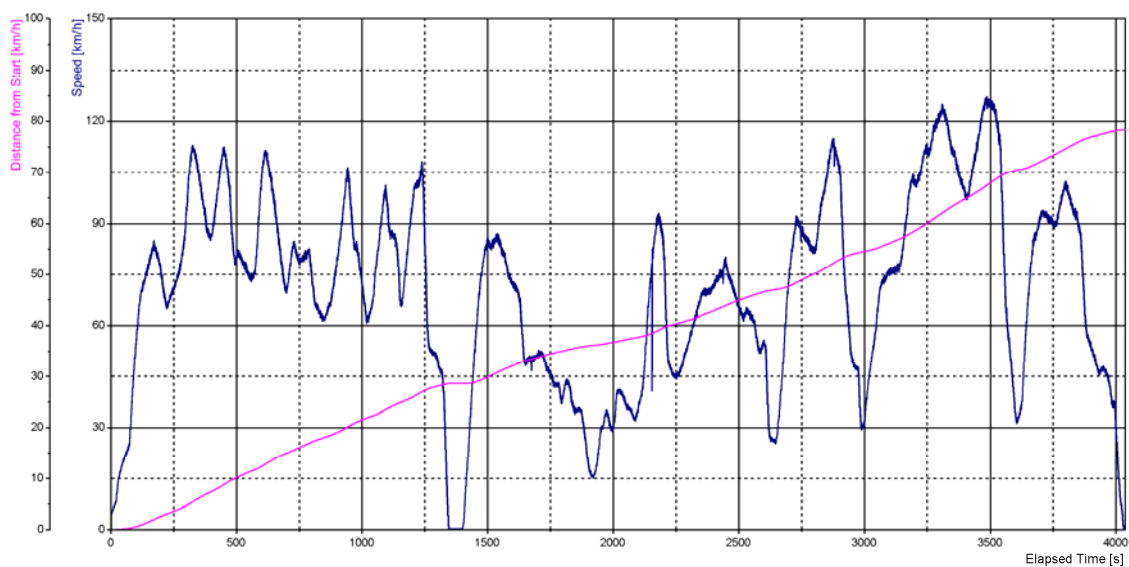
M Set Comparative Ride Test - Penrith to about Westmead on 7 September 2002



9b) Cumulative Distance (Speed vs Distance)

M Set Ride Tests on 7 September 2002

Berowra to Penrith via Strathfield Triangle



Job Number E2005002

M1Test2\_2002\_09\_07



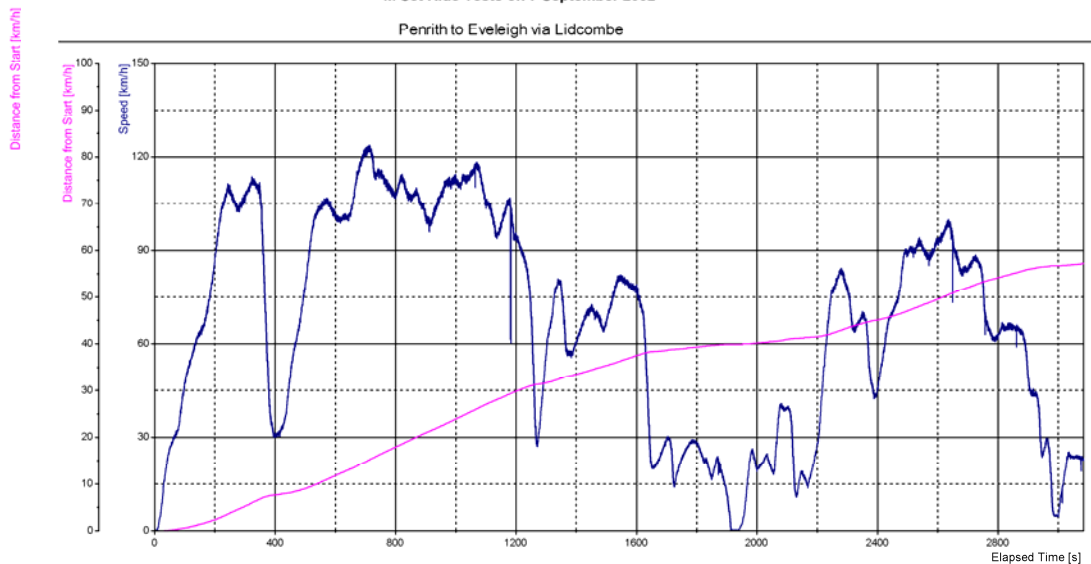
Job Number E2005002

M1Test4\_2002\_09\_07

RIC Engineering Investigation

M Set Ride Tests on 7 September 2002

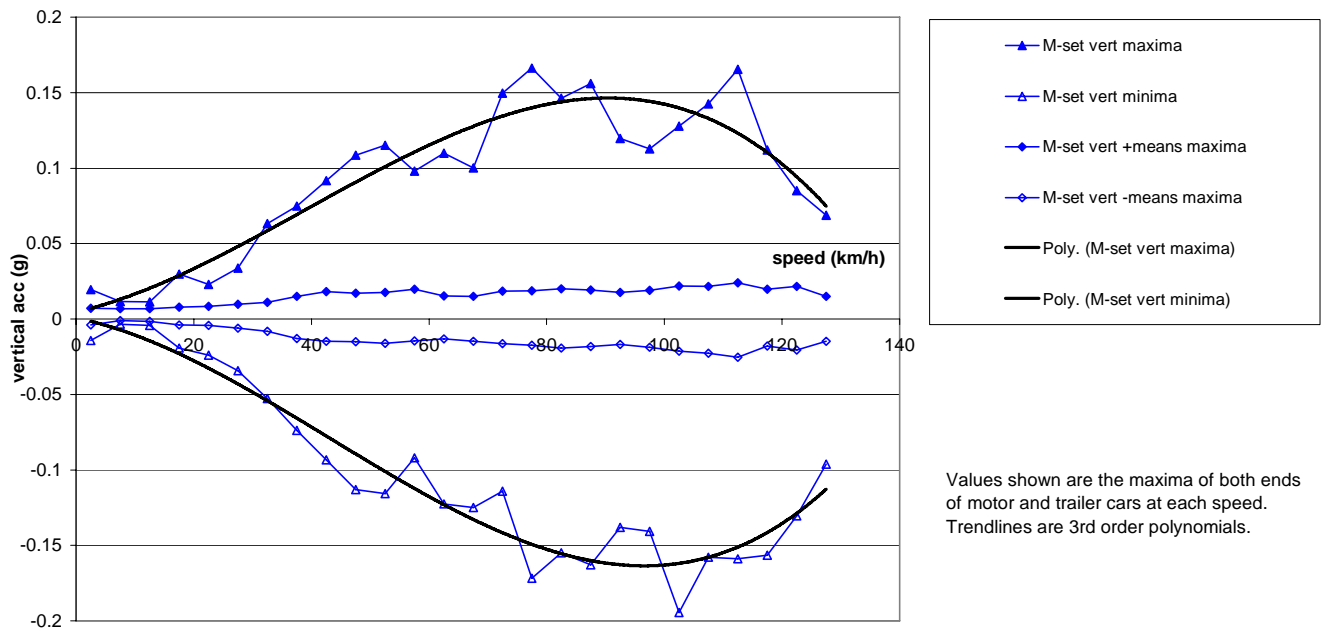
Penrith to Eveleigh via Lidcombe



9c) Acceleration versus Speed histograms (NVAS)

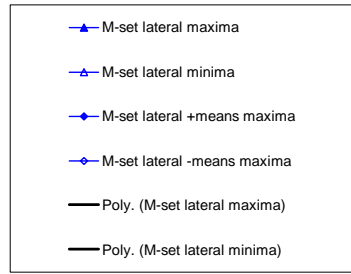
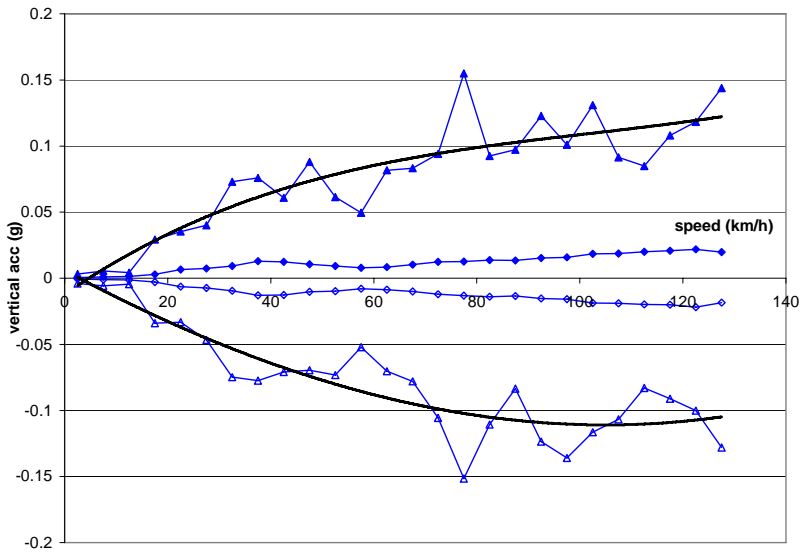
Berowra to Penrith via Homebush Goods

M-set NVAS, Vertical, Peak & Mean acceleration values (g)





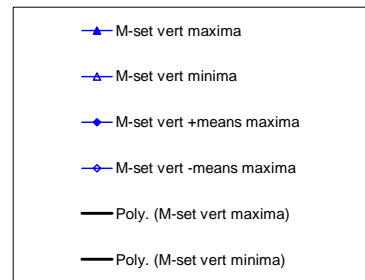
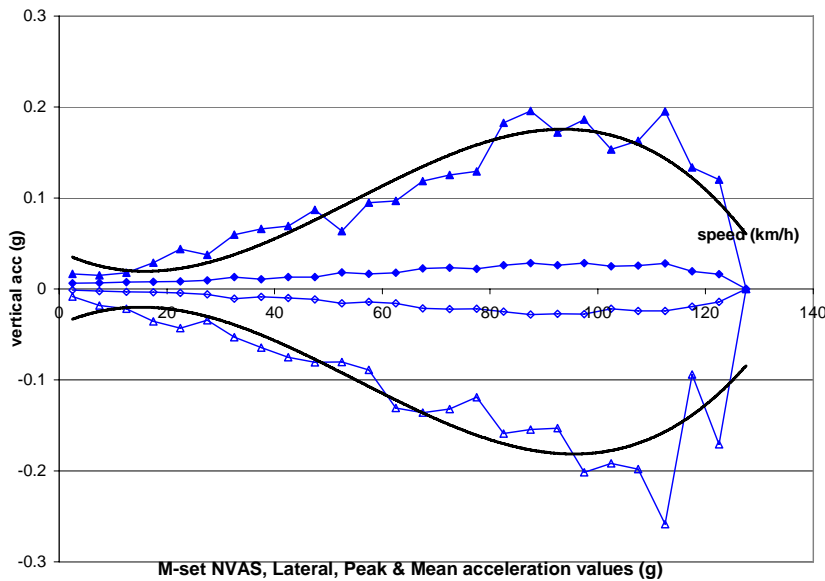
M-set NVAS, Lateral, Peak & Mean acceleration values (g)



Values shown are the maxima of both ends of motor and trailer cars at each speed. Trendlines are 3rd order polynomials.

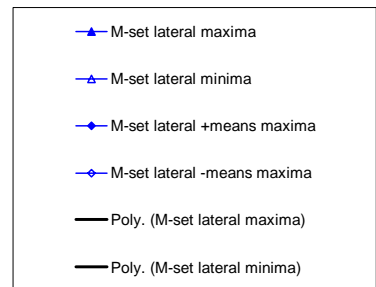
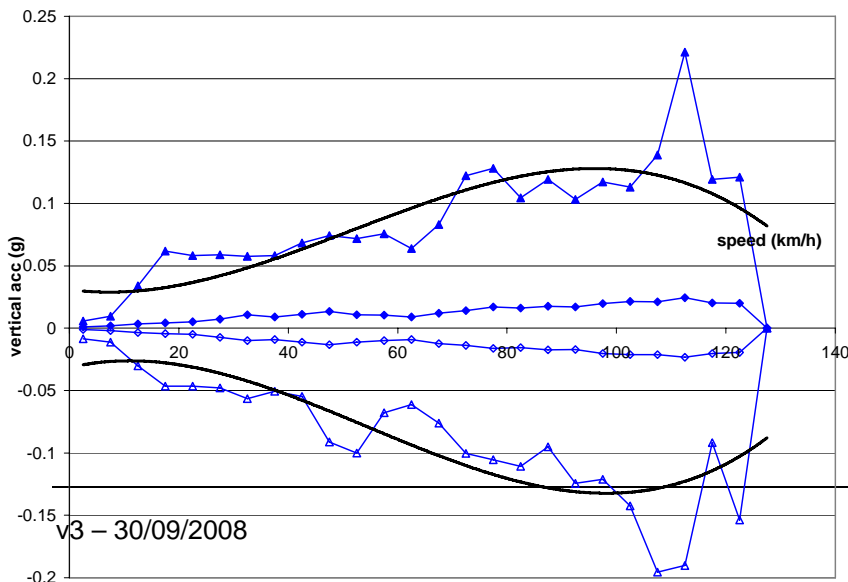
Penrith to Eveleigh

M-set NVAS, Vertical, Peak & Mean acceleration values (g)



Values shown are the maxima of both ends of motor and trailer cars at each speed. Trendlines are 3rd order polynomials.

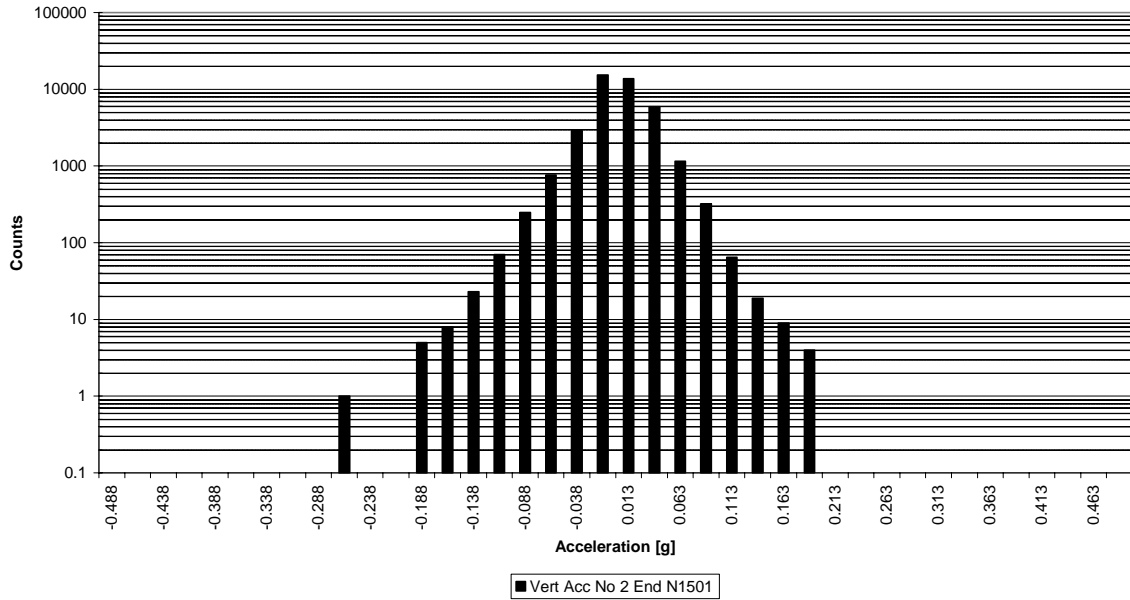
M-set NVAS, Lateral, Peak & Mean acceleration values (g)



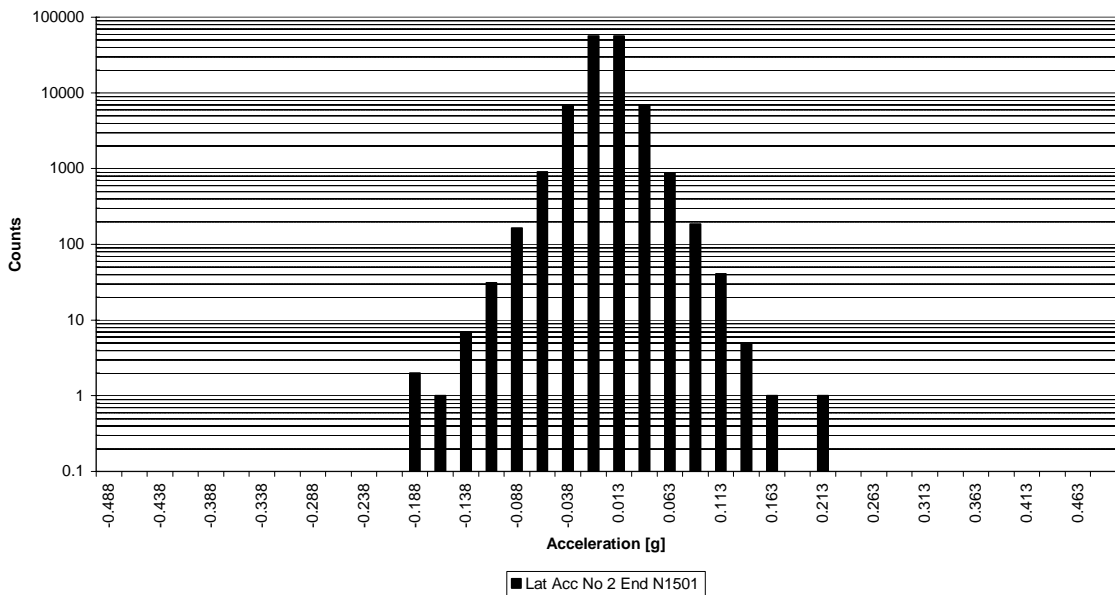
Values shown are the maxima of both ends of motor and trailer cars at each speed. Trendlines are 3rd order polynomials.

9d) Acceleration Histogram (cumulative count)

**M-set Ride Test on 7 September 2002**  
**Vertical Acceleration Zero Crossing Counts - Cumulative Sum of Motor Car #2 End**

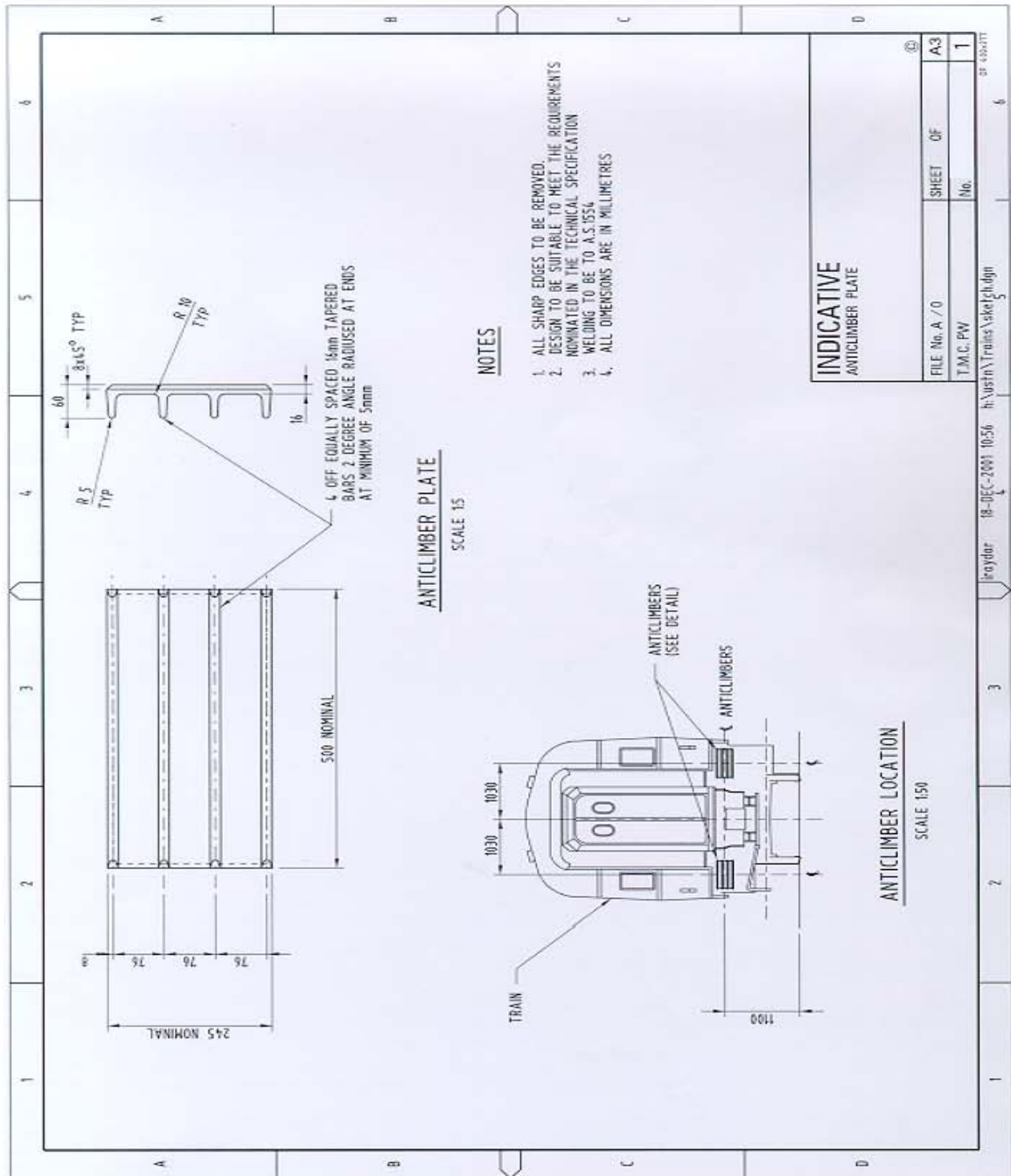


**M-set Ride Test on 7 September 2002**  
**Lateral Acceleration Zero Crossing Counts - Cumulative Sum of Motor Car #2 End**





# APPENDIX G – ANTI-CLIMBER



## APPENDIX H – CAB LAYOUT

**Note:** The images shown are indicative of the Cab arrangement sought by RailCorp. PPP Co shall aim to maximise consistency of layout with the images shown subject to compliance with the Contract requirements and consultation with user groups during the Mock-up and other design development stages.



Figure 1: Cab Layout – Driver's Workstation



Figure 2: Cab Layout – Guard's Workstation

**APPENDIX I – CREW CONTROLS AND WORKSTATION****Change Log**

<b>Issue</b>	<b>Date</b>	<b>Author</b>	<b>Change</b>
v4	CONTRACT		
v5	30/06/2009	ARJS	Addition of text changes from RFTA Group 12: 00051  Addition of text changes from ungrouped RFTA: 00198

	GROUP	FUNCTION	DRIVER	GUARD
1.0	<b>Traction</b>	Master Controller (combined traction and brake controller) shall incorporate a traction control handle with Operator Enable Pedal, key switch(es) and reverser handle	✓	
1.1		Vigilance Control indicator and acknowledgment	✓	
1.2		Driver's safety system foot pedal incorporated into the adjustable footrest	✓	
1.3		Speedometer analogue display	✓	✓
1.4		Analogue display of equivalent tractive effort for both powering and Brake Performance Indication	✓	✓
1.5		Overhead line voltage	✓	
1.6		not used		
1.7		Pantograph raise / lower for all pantographs	✓	
2.0	<b>Braking</b>	Master Controller (combined traction and brake controller)	✓	
2.1		Guard's Emergency Brake Handle		✓
2.2		[Driver's brake valve isolating switch if required]	✓	
2.3		Air pressure analogue displays for Main reservoir, Brake Pipe and brake cylinder pressure for each of that control trailer car's bogies	✓	✓
2.4		Train Park Brake control and indicator lights	✓	✓
2.5		[Trip gear controls if required ]	✓	
2.6		EP Brake cut out control	✓	
3.0	<b>Train Management</b>	Train Operating System	✓	✓
3.1		Train Stabling / Un-stabling button (located/designed such that it cannot be accidentally operated)	✓	✓
4.0	<b>Lighting and Visibility</b>	Time table Light/Switch /Clip	✓	✓
4.1		Down/Reading light from Coiling	✓	✓
4.2		Marker Light Switches	✓	
4.3		Headlight Switch	✓	✓
4.4		Headlight Fail Indicator	✓	
4.5		Fog Light Switch	✓	✓
4.6		Saloon light on switch	✓	✓
4.7		Step lights on & off switch(es)	✓	✓
4.8		Crew cab light control	✓	✓
4.9		Panel & Gauge lights dimmer switch	✓	✓
4.10		Indicator Light Test switch	✓	✓
4.11		Windscreen Wiper Control	✓	
4.12		A. Off	✓	
4.13		B. Intermittent	✓	
4.14		C. Continuous (shall be graded slow, medium and fast)	✓	
4.15		Windscreen Washer Control	✓	
4.16		Demister Control	✓	
4.17		not used		
5.0	<b>Climate Control</b>	Air conditioning Control	✓	✓
5.1		Ventilation Controls	✓	✓
5.2		Heater Control	✓	✓
5.3		Heaters, one above Driver's feet, one adjacent to Driver	✓	
5.4		Guard's heater		✓
5.5		Fresh air damper	✓	✓
6.0	<b>Door Control</b>	Door Indicator Light	✓	✓
6.1		Provision for passenger door control panel	✓	
6.2		Passenger door control panel		✓
6.3		Crew bodyside access door controls	✓	✓
6.4		Emergency close for crew bodyside doors	✓	✓
6.5		Traction Interlock Indicator	✓	
7.0	<b>Communication Control</b>	Passenger help point indicator	✓	✓
7.1		Intercom / PA (handset/control console)	✓	✓
7.2		Communication control station, including Train Radio	✓	✓
7.3		Portable train radio including radio, charger and holder	✓	✓
7.4		Destination Indicator panel control	✓	
7.5		DVA		✓
7.6		Horn Controls	✓	
7.7		Bell Button	✓	✓
7.8		Public Address System	✓	✓
7.9		CCTV monitor/control station	✓	✓
7.10		Commercial Radio	✓	✓
8.0	<b>Others</b>	Electric Kettle (cordless, with locking base)	✓	✓
8.1		Space for Diagram Book	✓	
8.2		Cup Holder	✓	✓
8.3		Adjustable Footrest Controls	✓	
8.4		240 volt, 50Hz, 10A for General Purpose Outlet	✓	✓
8.5		Space for A4 timetable		✓

**Definitions:**

<b>GUARD'S LOCATION</b>	Local Guard's desk area, excluding the controls located on the Guard's side door pillar.
<b>ACTIVE GUARD'S LOCATION</b>	Local Guard's desk area within an Active Guard's Workstation, excluding the controls located on the Guard's side door pillar.
<b>OTHER LOCATION IN CAB</b>	Any other location in the Cab including the local cab back wall and controls mounted on the Driver's and Guard's side door pillars.
<b>NO ACTIVE WORKSTATION</b>	Set is in Prepared – No Crew Mode (Set is powered up with 415V/240V AC, 110V DC available – No active crew cabs on the Set)

**Key:**

	Function shall not be available in this location.
✓	Function shall be available to the Crew member concerned in this location.
X	Function shall not be available to the Crew member concerned in this location.
[Blank]	Function need not be available in this location.

	GROUP	FUNCTION	AVAILABLE TO DRIVER			AVAILABLE TO GUARD			NO ACTIVE WORKSTATION
			ACTIVE DRIVER'S WORKSTATION	GUARD'S LOCATION	OTHER LOCATION IN CAB	DRIVER'S WORKSTATION	ACTIVE GUARD'S LOCATION	OTHER LOCATION IN CAB	
1.0	Traction	Master Controller (combined traction and brake controller) shall incorporate a traction control handle with driver detection device, key switch(es) and reverser handle	✓			X			X
1.1		Vigilance Control indicator and acknowledgment	✓			X			X
1.2		Driver's safety system foot pedal (Operator Enable Pedal) incorporated into the adjustable footrest	✓			X			X
1.3		Speedometer analogue display	✓	✓		✓	✓		✓



	GROUP	FUNCTION	AVAILABLE TO DRIVER			AVAILABLE TO GUARD			NO ACTIVE WORKSTATION
			ACTIVE DRIVER'S WORKSTATION	GUARD'S LOCATION	OTHER LOCATION IN CAB	DRIVER'S WORKSTATION	ACTIVE GUARD'S LOCATION	OTHER LOCATION IN CAB	
1.4		Analogue display of equivalent tractive effort for both powering and Brake Performance Indication	✓	✓		✓	✓		✓
1.5		Overhead line voltage display	✓						
1.6		not used							
1.7		Pantograph raise for all pantographs	✓			✓			X
1.8		Pantograph lower for all pantographs	✓			✓			✓
2.0	Braking	Master Controller (combined traction and brake controller). (1) Note: – Emergency Brake Application is always available (see clauses 7.3.3.2 & 7.3.3.3)	✓			X <sup>(1)</sup>			X <sup>(1)</sup>
2.1		Guard's Emergency Brake Handle			✓			✓	✓
2.2		[Driver's brake valve isolating switch if required]	✓			X			X
2.3		Air pressure analogue displays for Main reservoir, Brake Pipe and brake cylinder pressure for each of that control trailer car's bogies	✓	✓		✓	✓		✓
2.4		Train Park Brake control and indicator lights. (2) Note: - See clauses 10.3.16.1 & 10.3.16.2.	✓			✓ <sup>(2)</sup>			✓ <sup>(2)</sup>
2.5		[Trip gear controls if required ]	✓			X			X
2.6		Brake Test incorporating the EP Brake cut out control	✓			X			X

	GROUP	FUNCTION	AVAILABLE TO DRIVER			AVAILABLE TO GUARD			NO ACTIVE WORKSTATION
			ACTIVE DRIVER'S WORKSTATION	GUARD'S LOCATION	OTHER LOCATION IN CAB	DRIVER'S WORKSTATION	ACTIVE GUARD'S LOCATION	OTHER LOCATION IN CAB	
3.0	Train Management	Train Operating System	✓	✓		✓	✓		✓
3.1		Train Stabling button following removal of all keys (located/designed such that it cannot be accidentally operated)			✓			✓	✓
4.0	Lighting and Visibility	Time table Light/Switch /Clip	✓			✓			✓
4.1		Down/Reading light from Ceiling	✓	✓		✓	✓		✓
4.2		Marker Light Switches	✓			✓			✓
4.3		Headlight Switch	✓			✓			X
4.4		Headlight Fail Indicator	✓			✓			
4.5		Fog Light Switch	✓			✓			x
4.6		Saloon light on switch	✓			✓			
4.7		Step lights on & off switch(es)	✓	✓		✓	✓		✓
4.8		Crew cab light control	✓	✓		✓	✓		✓
4.9		Panel & Gauge lights dimmer switch	✓			✓			X

	GROUP	FUNCTION	AVAILABLE TO DRIVER			AVAILABLE TO GUARD			NO ACTIVE WORKSTATION
			ACTIVE DRIVER'S WORKSTATION	GUARD'S LOCATION	OTHER LOCATION IN CAB	DRIVER'S WORKSTATION	ACTIVE GUARD'S LOCATION	OTHER LOCATION IN CAB	
4.10		Indicator Light Test switch	✓			✓			✓
4.11		Windscreen Wiper Control	✓			✓			X
4.12		A. Off	✓			✓			X
4.13		B. Intermittent	✓			✓			X
4.14		C. Continuous (shall be graded slow and fast)	✓			✓			X
4.15		Windscreen Washer Control	✓			✓			X
4.16		Demister Control	✓			✓			X
4.17		not used							
4.18		Windscreen Wiper Selector Switch	✓			✓			
4.19		Coupler Light Switch	✓			✓			
5.0	<b>Climate Control</b>	Cab air conditioning control	✓	✓		✓	✓		✓
5.1		Cab ventilation controls	✓	✓		✓	✓		✓
5.2		Driver's heater control (adjacent to Driver)	✓	X			✓		X

	GROUP	FUNCTION	AVAILABLE TO DRIVER			AVAILABLE TO GUARD			NO ACTIVE WORKSTATION
			ACTIVE DRIVER'S WORKSTATION	GUARD'S LOCATION	OTHER LOCATION IN CAB	DRIVER'S WORKSTATION	ACTIVE GUARD'S LOCATION	OTHER LOCATION IN CAB	
5.3		Driver's foot heater control	✓	X			✓		X
5.4		Guard's heater control	✓			X	✓		X
5.5		Train fresh air damper	✓			X			X
5.6		Crew fresh air damper	✓			✓	✓		✓
6.0	Door Control	Door Indicator Light			✓			✓	
6.1		Future Provision for passenger door control panel (D.O.O)	✓						X
6.2		Passenger door control panel			X			✓	X
6.3		Crew bodyside access door controls	✓		✓	✓		✓	✓
6.4		Emergency close for crew bodyside doors			✓			✓	✓
6.5		Traction Interlock Indicator	✓			✓			
6.6		Car overshoot pushbuttons			X			✓	X
RFTA 00198	6.7	Passenger bodyside EDR Stage 1 Activation indicator light			✓ <sup>2</sup>			✓ <sup>3</sup>	✓
RFTA 00198	6.8	Passenger bodyside EDR Crew Override by illuminated push button			✓ <sup>2</sup>			✓ <sup>3</sup>	X <sup>1</sup>

	GROUP	FUNCTION	AVAILABLE TO DRIVER			AVAILABLE TO GUARD			NO ACTIVE WORKSTATION
			ACTIVE DRIVER'S WORKSTATION	GUARD'S LOCATION	OTHER LOCATION IN CAB	DRIVER'S WORKSTATION	ACTIVE GUARD'S LOCATION	OTHER LOCATION IN CAB	
		<u>Note 1: Refer to configurable option in clause 6.7.2.3.5(ii)</u>							
<u>RFTA 00198</u>	6.9	<u>Passenger bodyside EDR Crew Override Cancel by push button</u>			✓			✓	X
<u>RFTA 00198</u>	6.10	<u>Passenger bodyside EDR Stage 2 Activation indicator light</u>			✓			✓	✓
	7.0	<b>Communication Control</b> Passenger help point indicator	✓	✓	✓	✓	✓	✓	
	7.1	Intercom / PA (handset/control console)	✓		✓	✓		✓	X
	7.2	Communication control station, including Train Radio	✓		✓	✓		✓	X
	7.3	Space for Portable train radio	✓			✓			✓
	7.4	Destination Indicator panel control	✓	X		✓	✓		X
	7.5	DVA	✓	X		✓	✓		X
	7.6	Horn Controls	✓			✓			✓
	7.7	Bell Button. (3) Note: – See clause 11.6.2 [and as amended by RFTA 00071]	✓(3)	✓(3)	✓(3)	✓(3)	✓(3)	✓(3)	X
	7.8	Public Address System	✓		✓	✓		✓	X

	GROUP	FUNCTION	AVAILABLE TO DRIVER			AVAILABLE TO GUARD			NO ACTIVE WORKSTATION
			ACTIVE DRIVER'S WORKSTATION	GUARD'S LOCATION	OTHER LOCATION IN CAB	DRIVER'S WORKSTATION	ACTIVE GUARD'S LOCATION	OTHER LOCATION IN CAB	
7.9		CCTV monitor/control station			✓			✓	X
7.10		Commercial Radio	✓			✓			
8.0	Others	Electric Kettle (cordless, with locking base)	✓			✓			
8.1		Space for Diagram Book	✓			✓			✓
8.2		Cup Holder	✓	✓		✓	✓		✓
8.3		Adjustable Footrest Controls	✓			✓			
8.4		240 volt, 50Hz, 10A for General Purpose Outlet	✓			✓			✓
8.5		Space for A4 timetable		✓			✓		✓
8.6		Uncouple Pushbutton	✓			X			X
8.7		Safety system (EMPB). (4) Note: - See clause 7.9.2 for the control functionality.		(4)			(4)		X <sup>(4)</sup>

RFTA  
00198

Note 1: Refer to clause 6.7.2.3.5 (i) and configurable option clause 6.7.2.3.5(ii)

Note 2: Controls shall only be illuminated when there is no active guard's workstation, refer to clause 7.8.5.

Note 3: Controls shall be illuminated in the event that the active guard's and driver's workstations are in the same cab, refer to clause 7.8.5.

**APPENDIX J – DDA REQUIREMENTS****Guidelines for compliance with the Disability Standards for Accessible Public Transport****Change Log**

<b>Issue</b>	<b>Date</b>	<b>Author</b>	<b>Change</b>
v2	CONTRACT		
v3	11/02/2009	ARJS	Addition of text changes from RFTA00005 (RFTA Group 7)

1. The Disability Standards for Accessible Public Transport 2002 and Amendments (Nos 1 and 2) 2004 (the "Standards") are made pursuant to section 31(1) of the federal Disability Discrimination Act 1992 (DDA).
2. A review of the Standards by Australian rail operators is currently in progress with a view to submit to the Human Rights and Equal Opportunity Commission (HREOC) that certain Standards relevant to train design be amended.
3. RailCorp will make information available to prospective proponents on relevant progress of the submission to amend the Standards and the subsequent consultative process.
4. Prospective proponents should monitor HREOC's website ([www.humanrights.gov.au](http://www.humanrights.gov.au)) for outcomes relating to the Standards that may affect the compliance requirements for rail car design.
5. Pending possible outcomes displayed on the HREOC website, tendered designs must comply with the Standards except in the following areas:
  - 5.1. Internal stairs – in relation to Clause 14.3 of the Standards, the functionality and compliance level of the tendered design for the geometry of internal stairs shall be equal to or better than the following dimensions, allowing for reasonable engineering tolerances:
    - 5.1.1. Riser Height: 150 mm to ~~184~~189 mm;
    - 5.1.2. Going Depth: 255 mm to 300 mm; and
    - 5.1.3. Width: to be maximised, for acceptance by RailCorp. The design width will be accepted by RailCorp provided that PPP Co demonstrates to the reasonable satisfaction of RailCorp that:
      - a) PPP Co has considered a reasonable range of design options to maximise compliance with the Standards;
      - b) PPP Co has comprehensively documented the technical factors that constrain the design; and
      - c) The design of the Set as a whole provides equivalent functionality for people with a range of disabilities.
  - 5.2. If the stairs are not fully compliant, equivalent access shall be achieved by providing all facilities for passengers with a disability (including hearing augmentation) on the single deck level.
  - 5.3. Handrails and grabrails – in relation to Clauses 11.4 and 11.5 of the Standards – placement of controls / equipment above or adjacent to hand / grabrails, tendered designs must comply to the maximum extent possible and avoid installing passenger controls / equipment in the area 600mm above the rail. Hand / grab rails may need to be recessed provided that compliant wall clearance and dimensions are achieved.
  - 5.4. Access path to allocated wheelchair spaces – in relation to Clauses 2.6 and 2.8 of the Standards, the tendered design shall achieve a compliant access path between allocated wheelchair spaces to the maximum extent possible. When allocated spaces are occupied, a reasonable amount of manoeuvring may be required by passengers with mobility aids to maintain a clear access path to both the passenger bodyside and intercar doors.

RFTA 00005
---------------



## APPENDIX K – TRAIN OPERATING SYSTEM

### Change Log

Issue	Date	Author	Change
v8	CONTRACT		
v9	29/09/2008	CJEH	Addition of text changes from RFTA Group 1: 00213    00214    00216
v10	17/03/2009	ARJS	Addition of text changes from RFTA Group 7: 00210    00278  Addition of text changes from RFTA Group 8: 00243
v11	08/04/2009	ARJS	Addition of text changes from RFTA Group 9: 00212
v12	21/04/2009	ARJS	Addition of text changes from RFTA Group 11: 00215    00217    00311

<b>Issue</b>	<b>Date</b>	<b>Author</b>	<b>Change</b>
v13	30/06/2009	ARJS	Addition of text changes from RFTA Group 12: 00315  Addition of text changes from the following RFTAs (No Group): 00022  Formal inclusion of text changes arising from letter RC00273 dated 27/06/2007 – <i>Pre-agreed Variation</i> .
v14	17/01/2011	ARJS	Addition of text changes from: 00363

## Functional Requirements

1.0	TOS Functionality	
1.1		The TOS shall be capable of displaying the information detailed in the Systems Monitoring Requirements section included in this appendix.
1.2		The TOS functionality shall include but not be limited to the information defined in this document.
1.3	Driver's and Guard's Information	<p>The TOS shall display the Driver's and Guard's information on the interface screens.</p> <p>The relevant log on screens shall be activated on Driver butterfly or Guard key activation. Should no information be entered into the TOS then train systems shall start normally but shall remain set at default settings. PPP Co shall agree these defaults with RailCorp.</p>
1.4	Main Operations Screen	The TOS screen shall display on the main operations screen: main reservoir pressure, Brake Pipe pressure, brake cylinder pressure and tractive effort. The TOS screen shall display the speedometer reading using both an analogue and digital representation.
1.5	Automatic Data Display	The TOS shall update data on the TOS screen automatically without a Crew request.
1.6	Train Control Information	The TOS shall display information to the Crew such that real time train control information is not displaced by Fault information.

<p>RFTA 00278</p> <p><u>RFTA 00215</u></p> <p>RFTA 00216</p>	1.7	Select and Display Data	<p>Display data automatically and display selected data upon request from the Crew or authorised persons.</p> <p>Display data to the Crew in an Active Crew Cab.</p> <p><del>Cease to display a</del> <u>As soon as a key is removed from the Active Crew Cab, the associated screen(s) shall revert to the V100 screen and then, after 5 minutes, to a blank screen unless touched again.</u></p> <p>Screen navigation <u>for the driver</u> shall not be allowed when the Set is in motion, with the exception of the pop up menus <u>and navigation to the main operations screen (D100) or to the main driver status screen (D101-1).</u></p> <p><u>A driver's TOS screen not set to a main screen (D100/D101) shall revert to D100 for the DDU-L, and D101-1 for DDU-R when the Set is in motion.</u></p> <p><del>A TOS screen not set to main status operations shall revert to that screen if touched when the train is in motion.</del></p>
	1.8	Information Ranking	<p>The TOS shall rank presented information and Fault alarms in order of significance with the following precedence:</p> <ol style="list-style-type: none"> <li>1. Safety</li> <li>2. Operational consequences</li> <li>3. Non-operational consequences.</li> </ol>
	1.9	Real Time Operating Display	It shall not be necessary for the Crew to clear or call up special screens to display Level 1 Diagnostic or Fault information. This information shall appear on the TOS screen as appropriate to the events monitored by the TOS.
	1.10	Real Time Monitoring	Real time monitoring of data being recorded by the ER shall be possible via a plug-in lap top computer.
	1.11	Store and Search	Store documentation for display on demand from the Crew at the TOS screen and provide the ability to search for information using keywords or similar shall be provided.
	1.12	Train Preparation	The TOS shall allow the Crew to commence and carry out Train Preparation from the TOS screen. This push button shall commence all the Train Preparation tests, which shall then run automatically to completion upon which the TOS shall display to the Crew the state of the Set

1.13	Train Certification Test (part of Train Preparation)	
1.14	Train Certification	Automate the testing of the Set to show that each set conforms to the Performance Operating Standards. All Train Preparation tests shall be commenced from the TOS screen as opposed to individually for each test.
1.15	Automatic Train Certification	<p>The Automatic Train Certification Test shall be conducted for all requirements in the Performance Operating Standards that do not require Crew certification.</p> <p>The Automatic Train Certification Test shall be conducted whenever the Set is unstabled and on demand from authorised personnel. The TOS shall conduct an Automatic Train Certification of each Set Subsystem to validate that each Subsystem is operating within its specification. This requirement shall not apply to the Train Radio System. The Automatic Train Certification Test results shall indicate a pass or fail result on the TOS screen for each Minimum Operating Standard tested. Each non complying result obtained from the Automatic Train Certification shall be analysed by the TOS as detailed in the Diagnose Data Capability</p>
1.16	Crew Train Certification	Crew Train Certification shall be conducted by the Crew for all requirements in the Performance Operating Standards that are not tested in the Automatic Train Certification Test. The Crew Train Certification Acknowledgment shall provide a checklist on the TOS screen of Crew required Performance Operating Standard checks and allow a suitable notation for each Crew certified standard to be recorded.
1.17	Diagnose Data Capability	
1.18	Level 1 Diagnostics	Level 1 diagnostic results shall consist of status, Fault information and recommended remedial action required to be undertaken by the Crew to maintain Set operating performance
1.19	Display Level 1 Diagnostics	Report the current level 1 diagnostic results to the Crew on request. This data shall be automatically stored for later retrieval.
1.20	Recall Level 1 diagnostics	The Crew shall be able to recall for display all level 1 diagnostic results that have been displayed within the last 24 hour period.
1.21	Search Level 1 Diagnostics	Crew shall be able to search through level 1 diagnostic results chronologically in both directions i.e. newest to oldest and vice versa.
1.22	Sort Level 1 Diagnostics	Level 1 diagnostic results shall be able to be sorted according to the Subsystems.

1.23	Level 1 Remedial Action	Level 1 diagnostic results shall include recommended remedial action required to be undertaken by the Crew
1.24	Display Diagnostics on the TOS screen	Display all diagnostic results in the Crew Cab to authorised staff
1.25	Clear Level 1 Diagnostic Results	Crew shall be able to acknowledge and clear their respective level 1 diagnostic results from the active TOS screen.
1.26	Fault Memory	<p>The Fault memory shall record all reported Faults such that each Fault is a dated record that is stored in a memory.</p> <p>Each Fault that is stored and defined by:</p> <ol style="list-style-type: none"> <li>1. Fault date</li> <li>2. Fault code</li> <li>3. Fault context</li> <li>4. Car number</li> </ol>
1.27		The memory shall allow a minimum of 1000 Faults to be stored and a capacity to store 2000 Faults is preferred. When the Fault memory is full, the oldest data shall be overwritten
1.28		The TOS shall be able to record Set status data continuously for not less than 240 hours of Set operation. When the data storage is full, the oldest data shall be overwritten
1.29		With the Set unpowered, the TOS shall retain the historical data and Fault records for not less than 1 year.
1.30	Access to TOS	The access mode shall be dedicated to the Crew during Set service operation.
1.31		Information retrieved by the TOS monitoring functions shall be displayed to the Crew on the TOS screen

	1.32		There shall be 3 levels of access for the operation of the TOS as follows: <ol style="list-style-type: none"> <li>1. Driver Mode;</li> <li>2. Guard Mode; and</li> <li>3. Maintenance Mode.</li> </ol>
	1.33	Display Units	The TOS screen shall provide a flat, touch screen display that is the main interface to the TOS.
	1.34		Each TOS screen shall have display unit brightness controls and an appropriate day and night time view.
	1.35		2 identical TOS screens shall be provided in the Driver's Console of each Cab and 1 TOS screen on each Guard's Console.
RFTA 00213	1.36		The functions available to the Driver shall be identical on both TOS screen screens but <del>it shall not be possible to display</del> <u>shall not be restricted to only showing</u> the same information simultaneously on both screens.
RFTA 00311	1.37		<p>If one TOS screen fails the Driver shall be able to quickly change the display from the failed screen to the operating screen.</p> <p><del>The background of the upper right hand corner of the screen shall be neutrally coloured when the TOS is operating normally. If an internal TOS or TOS communication defect is detected then this colour shall change to amber.</del></p> <p>In addition, there shall be a moving icon that will rotate whenever the TOS is in the normal condition and freeze under failure conditions.</p>
	1.38		The TOS screen and TOS screen shall update automatically without input from the Driver/Guard
	1.39		The TOS screen shall have adjustable brightness (from the operations screen) and be glare resistant.
	1.40	Not Used	
	1.41	Not Used	

1.42	Not used	
1.43	Online Help	<p>Provide an online help facility, unless it can be demonstrated that the System is so intuitively simple that it does not require online help.</p> <p>The TOS shall include a Fault finding manual that has a keyword search capability.</p> <p>The help facility shall include guidance on the minimum operating standard for the train and on the approach that the train crew should adopt to deal with any failure in the trains operating context.</p>



### System Monitoring Requirements

2.0	System Description	Task to be performed	
2.1		The TOS shall monitor the status of the following Systems	
<div style="border: 1px solid black; padding: 2px;">RFTA 00217</div>	Monitoring Functions	<ol style="list-style-type: none"> <li>1. Door status</li> <li>2. Brakes status</li> <li>3. HVAC status</li> <li>4. Lighting status</li> <li>5. Destination Indicator status</li> <li>6. Audio communication status</li> <li>7. Surveillance System status</li> <li>8. Traction Subsystem status</li> <li>9. Auxiliary Subsystem status</li> <li>10. Air Supply System Status</li> <li>11. Status of other equipment</li> </ol>	<ol style="list-style-type: none"> <li>12. Train speedometer</li> <li>13. Energy and main power measurements</li> <li>14. Crew access control</li> <li>15. TOS sub-functions</li> <li>16. Air supply status</li> <li>17. Data radio status</li> <li>18. Monitor Vigilance System</li> <li>19. Display time and date</li> <li>20. PEI Status</li> <li>21. Monitor Operator Enable System</li> <li><u>22. Fire Detection System Status</u></li> </ol>
2.3	Train Certification	The TOS shall provide a Train Certification functionality to test and qualify various systems or areas throughout the Setbefore it is allowed to go into service. The Train Certification functionality shall allow an automatic qualification of the System as well as the status of the test.	

RFTA 00217	2.4	Train Certification Tests	<table border="0"> <tr> <td>1. Traction</td> <td>10. Speedometer</td> </tr> <tr> <td>2. Brakes – EP and Auto</td> <td>11. Cab Equipment</td> </tr> <tr> <td>3. Vigilance System, Tripgear and Operator Enable System</td> <td>12. Passenger Interior</td> </tr> <tr> <td>4. Doors</td> <td>13. Exterior</td> </tr> <tr> <td>5. Climatic Control</td> <td>14. Isolating Cocks</td> </tr> <tr> <td>6. Surveillance</td> <td>15. Gangway</td> </tr> <tr> <td>7. Auxiliary Power</td> <td>16. Emergency Equipment</td> </tr> <tr> <td>8. Air Supply</td> <td>17. Emergency Coupler</td> </tr> <tr> <td>9. Communications</td> <td><u>18. Fire Detection System</u></td> </tr> </table>	1. Traction	10. Speedometer	2. Brakes – EP and Auto	11. Cab Equipment	3. Vigilance System, Tripgear and Operator Enable System	12. Passenger Interior	4. Doors	13. Exterior	5. Climatic Control	14. Isolating Cocks	6. Surveillance	15. Gangway	7. Auxiliary Power	16. Emergency Equipment	8. Air Supply	17. Emergency Coupler	9. Communications	<u>18. Fire Detection System</u>
1. Traction	10. Speedometer																				
2. Brakes – EP and Auto	11. Cab Equipment																				
3. Vigilance System, Tripgear and Operator Enable System	12. Passenger Interior																				
4. Doors	13. Exterior																				
5. Climatic Control	14. Isolating Cocks																				
6. Surveillance	15. Gangway																				
7. Auxiliary Power	16. Emergency Equipment																				
8. Air Supply	17. Emergency Coupler																				
9. Communications	<u>18. Fire Detection System</u>																				
	2.5	Distance	The Set cumulative kilometre figure shall be held on the Set in a manner that ensures the total Set kilometres is not lost when equipment on the Set is changed out.																		
RFTA 00315	2.6	Reset Functionality	<p>The TOS shall provide access to <del>the Crew</del> <u>maintenance personnel</u> to enable Set systems to be <del>reset</del> <u>isolated and de-isolated</u>.</p> <p>The <del>resets</del> <u>isolation functions</u> available to the Crew from the TOS screens <u>when in maintenance mode</u> shall include traction air conditioning, <u>and electrical auxiliary supply and communications</u> as a minimum unless otherwise agreed with RailCorp. <del>PPP Co</del> shall present a reset scheme for agreement. The basis of resetting is proposed to be that the Crew shall have three chances to manually reset the equipment and if none is successful then the equipment shall be deemed a failure and appropriate action taken to isolate the equipment</p>																		
	2.7	<b>System Description</b>	<b>Task to be performed</b>																		
	<b>2.8</b>	<b>Access Subsystem</b>																			

	2.9	Intercar Door Locking	Monitor Passenger intercar door lock status during stabling and isolation and identify any door locks or locking mechanisms that are in an incorrect state
	2.10	Crew Cab Security	Monitor and provide indication and location if any Crew Cab side door is open, opened or unlocked above the set speed point or in the wash mode or is subject to any unauthorised opening.
	2.11	Passenger Doors	Monitor open/close/release state of Passenger doors.  Monitor location of any doors that fail to operate or are in an incorrect state  Monitor door locking, including the traction interlock and the location of any doors that fail to lock/unlock when required, or are slow to operate.  Monitor and indicate individual or pairs of doors that are locally isolated or cut-out.  Indicate doors that fail to un-isolate when required.  Monitor the Nightsafe door status
RFTA 00022	2.12	Emergency Door Release	The TOS shall display to the Crew any <del>tampering or mis-use</del> <u>Stage 1 or Stage 2 Activation</u> of the Emergency Door Release as described in Clauses 6.7.2.3 and 6.7.4.3 of the Train Performance Specification. <del>control and</del> The TOS shall also display to the Crew <u>any deployment of</u> the emergency ramp
	2.13	<b>Brake Equipment</b>	The TOS shall monitor EP Brake Fault, Brake not releasing, Brake not applied, bogie Brakes isolated, air Brake Pipe pressure, wheelslide Fault while braking, excessive Brake application/release Time
	2.14		Monitor the Brake mode on each car of the Set
	2.15		Monitor the Brake Control Unit status on each car of the Set
	2.16		Monitor the Wheel Slide Control Unit status on each car of the Set
	2.17		Monitor the Park Brake status

	2.18		Monitor the Trip Cock status
	2.19		Monitor the Vigilance System status
	2.20	Brake Controller	Monitor the state of the Brake controller and record any Faults that occur
	2.21	Park Brake Incorrect State	Identify each Park Brake that is in an incorrect state.  Detect any park Brakes that have not responded to the command signal.
	2.22	Brake Values	Monitor the Main Reservoir pressure
	2.23		Monitor the Brake Pipe pressure
	2.24		Monitor the Brake Cylinder pressure
	2.25	Brake Pipe Pressure	Monitor and display to the Driver and authorised personnel the terminal end car's Brake Pipe pressure to ensure Set Brake Pipe continuity
RFTA 00217	2.26	<b>HVAC</b>	Monitor Passenger saloon temperatures, Climate Control cut-out, Climate Control Fault, Climate Control isolation, Passenger saloon over/under-temperature, Fresh air supply Faults, Blocked filters, Compressor Faults, fan motor Faults, Faults in electronic motor control systems, Logic and control System Faults, <del>and smoke</del>
	2.27		Monitor the Cab Fresh Air Supply and Cab HVAC [monitor and display temperature and air flow rate settings]
	2.28	<b>Lighting Subsystem</b>	
	2.29	Monitor Head Light	Monitor, display and record the operational state of the headlight high beam
	2.30	Passenger Lights	Monitor, display and record the failure of the Main Passenger Lights and Emergency Passenger Lights
	<b>2.31</b>	<b>Traction System</b>	The TOS shall monitor wheel slip/slide associated with powering and braking, low line voltage, line over voltage, traction motor or group overcurrent, 50 Hz detector operation, microprocessor control Fault, traction equipment cut-out and reset, traction

		motor overspeed, speed sensor failure, activation of thermal trips or over temperature protection, Electric Brake Faults indicating the type of Fault.
2.32	Monitor Traction Controller	Monitor the state of the traction controller and record any Faults that occur
2.32.1	Monitor use of get home facility	Monitor the use of the get home facility and provide warnings of use to Crew members
2.33	Traction Drives	Monitor individual traction drives to distinguish between wheel slip and defective mechanical drives and report defective mechanical drives to the Driver and authorised personnel.
2.34		Record and display all line voltage or low voltage discrepancies to Set Crew.
2.35	Overhead Power	When a loss of OHW power supply is detected, the MPS shall switch to the off state and remain in this condition. When OHW power supply is restored above 1100V, the MPS shall be enabled automatically and the TOS shall prompt the Driver to reset controls and re-initiate power.
2.36	Consumed Auxiliary Energy	Derive, record and display the energy consumed by the auxiliary Subsystem to the authorised personnel.
2.37	Consumed Traction Energy	Derive, record and display the traction energy consumed to the authorised personnel
2.38	Returned Electrical Braking Energy	Derive, record, and display the electrical braking energy returned to the OHW
2.39	Data Port	The TOS shall include a data port to allow traction information to be recorded by the Event Recorder.
	<b>Main Power Subsystem</b>	
2.40	Monitor HSCB	Monitor the overhead wire Set isolation System for Faults and display Fault information.
2.41	Monitor Line Voltage	Monitor and display the nominal OHW voltage.
2.42	Monitor Net Current	Monitor and display the net current usage.

		Monitor and display the current flowing in or out of each pantograph
2.43	Monitor Auxiliary Contacts	Monitor the state of agreed Main Power Supply auxiliary contacts and identify Faulty auxiliary contacts.
2.44	Net Energy Usage	Derive, Record and Display the net Set energy usage
2.45	Pantograph	Monitor the status (position) of the pantograph
2.46	<b>Auxiliary Power Subsystem</b>	
2.47	Auxiliary Power System (Electrical)	Monitor and display Battery voltage, AC voltage, Main Power Derived Supply Overcurrent, Battery Charger output, inverter cut-out , main power derived supply reset
2.48	Auxiliary Power System (Mechanical)	Monitor and display compressor Fault, compressor cut-out, main Reservoir charge time, compressor operating according to the compressor management System requirements.
2.49	Air Supply System	Monitor and display the air supply System signals for failures and isolation.
2.50	<b>Crew Control Subsystem</b>	Monitor and access Crew controls.  Record any unauthorised access to the Crew controls and display authorised access to Crew controls to the Crew.
2.51	<b>Communications Subsystem</b>	Monitor the operation of all communications equipment.
2.52	Controlled equipment	Advise the Crew of the state of all equipment controlled by the TOS, including equipment that is controlled automatically or manually by the Crew (including DVA, external DI, internal DI, PA, Intercom, Train Radio Power supply, surveillance cameras and recording systems.
2.53	PEI System	Monitor and record any PEI failure, incorrect deactivation, or failure to respond at start-up.
2.54	Destination Indicator	The TOS shall provide the Crew's interface to the Destination Indicator and DVA systems. The system shall include recovery features such that should the TOS system freeze and require resetting then any train running entered by the Crew shall be recoverable using a reset feature.

	2.55	<b>Bogie Subsystem</b>	Monitor secondary suspension and identify secondary suspensions that do not comply with the specification
	2.56	<b>Train Monitoring</b>	
	2.57	Train Speed	Monitor Train Speed in km/h
	2.58	Passenger Load	Compute Passenger load per set in kg and display the value on the TOS screen for test purposes
	2.59	Monitor Operator Enable System	Monitor that state of the Operator Enable System in the Active Crew Cab and record all Faults that occur.
RFTA 00217	<u>2.60</u>	<b><u>Fire Detection Sub System</u></b>	
RFTA 00217	<u>2.61</u>	<u>Monitor smoke</u>	<u>Monitor the status of the fire detection system and display internal and external smoke alarms.</u>

## Screen Design and User Interface

		Screen Design	
Letter RC00273	3.1	Display Units	<p>The TOS shall interface with the Crew via screens in each Crew Cab. The TOS screens shall display information to the Crew via a flat display, touch screen interface. Two TOS screens shall be provided at each Driver's Workstation, one TOS screen at each Guard's Workstation <del>in a Driver's Cab, and one TOS screen in each Guard's Cab.</del></p> <p>The functions available to the Driver shall be identical on both TOS screen but not at the same time.</p> <p>During normal operation it is expected that the Driver will select the real time Set operating information (traction &amp; braking parameters, speed, time, etc) on one screen while other data such as alarms and events are shown on the second screen.</p> <p>If one screen fails the Driver shall be able to quickly change the display from the failed screen to the operable screen.</p> <p>The ability of the Driver to interrogate various levels of the TOS while the Set is moving shall be agreed with RailCorp during the CDR of TOS/Crew Control.</p>
	3.2	Screen Resolution	The screen resolution of the TOS screen shall be 600X800 pixels or higher.
	3.3	Crew Data Entry	The TOS shall allow the Crew to enter Fault data as free form text of up to 128 characters per Fault
	3.4	Brake Performance Indication	TOS screen shall indicate an analogue representation of the total braking performance and the division of braking performance between friction, regenerative and rheostatic brakes
RFTA 00214	3.5	Display of Driver's Main Operating Screen at call	It shall be possible to call up the Driver's Main Operating Screen in any Cab of an unstabled Set to observe air pressures (Main Reservoir, Brake Pipe, Brake Cylinders), tractive effort, speed, and OHW voltage. When this screen is called up <del>in an Active Crew Cab on an inactive workstation,</del> it shall extinguish itself five minutes after the last operation.
RFTA 00363	3.6	Display Train's Traction Data	<del>One screen</del> The TOS shall display Set speed and for each motor car on the Set <u>as appropriate, the</u> Overhead line voltage, DC input/output line current, rheostatic brake <del>current effort</del> for both traction inverters, traction motor <del>phase</del> current for both traction inverters.
	3.7	Train Preparation	The TOS shall allow the Crew to commence and carry out the Train Preparation from the TOS screen.



3.8	Train Certification Test	
3.9	Train Certification	Automate the testing of the Set to show that each set conforms to the Performance Operating Standards. All Train Preparation test shall be commenced from the TOS screen as opposed to individually for each test.
3.10	Automatic Train Certification	<p>The Automatic Train Certification Test shall be conducted for all requirements in the Performance Operating Standards that do not require Crew certification.</p> <p>The Automatic Train Certification Test shall be conducted whenever the Set is unstabled and on demand from authorised personnel. The TOS shall conduct an Automatic Train Certification of each Set Subsystem to validate that each Subsystem is operating within its specification. This requirement shall not apply to the Train Radio System. The Automatic Train Certification Test results shall indicate a pass or fail result on the TOS screen for each Minimum Operating Standard tested. Each non-complying result obtained from the Automatic Train Certification shall be analysed by the TOS.</p> <p>During preparation the TOS shall poll the various train Sub-systems to confirm status. The timing of this polling shall be such as to allow all Sub-systems to respond in a valid manner having completed individual boot up routines.</p>
3.11	Crew Train Certification	Crew Train Certification shall be conducted by the Crew for all requirements in the Performance Operating Standards that are not tested in the Automatic Train Certification Test. The Crew Train Certification Acknowledgment shall provide a checklist on the TOS screen of Crew required Performance Operating Standard checks and allow a suitable notation for each Crew certified standard to be recorded.
3.12	Certificate of Readiness	The TOS shall be able to provide the Crew with the validity period of the Certificate of Readiness.
3.13	Level 1 Diagnostics	Level 1 diagnostic results shall consist of status, Fault information and recommended remedial action required to be undertaken by the Crew to maintain Set operating performance
3.14	Display Level 1 Diagnostics	Report the current level 1 diagnostic results to the Crew on request. This data shall be automatically stored for later retrieval.
3.15	Recall Level 1 diagnostics	The Crew shall be able to recall for display all Level 1 diagnostic results that have been displayed within the last 24 hour period.
3.16	Search Level 1 Diagnostics	Crew shall be able to search through Level 1 diagnostic results chronologically in both directions i.e. newest to oldest and vice versa.

3.17	Sort Level 1 Diagnostics	Level 1 diagnostic results shall be able to be sorted according to the Subsystems.
3.18	Level 1 Remedial Action	Level 1 diagnostic results shall include recommended remedial action required to be undertaken by the Crew
3.19	Display Diagnostics on TOS screen	Display all diagnostic results in the Crew Cab to authorised staff
3.20	Clear Level 1 Diagnostic Results	Crew shall be able to acknowledge and clear their respective Level 1 diagnostic results from the active TOS screen

## Maintainability

	<b>Maintainability</b>	
<b>4.0</b>	<b>Interface to Access Maintenance</b>	
4.1	Passenger Side Door timing	The TOS shall monitor Passenger side door timing whilst opening and closing and indicate to authorised personnel the location of any door timing outside specification.
4.2	Intercar Door timing	The TOS shall monitor Passenger intercar door timing whilst opening and closing and indicate to authorised personnel the location of any door timing outside specification.
<b>4.3</b>	<b>Interface to Brake System Maintenance</b>	
4.4	Brake Cylinder Application Time	The TOS shall monitor and display to the authorised personnel the application time for each bogie brake cylinder.
4.5	Brake Cylinder Pressure	The TOS shall monitor and display to the authorised personnel each bogie brake cylinder pressures.
4.6	Brake Cylinder Release Time	The TOS shall monitor and display to the authorised personnel the release time for each bogie brake cylinder.
4.7	Electric Braking Effort	The TOS shall monitor and display to the authorised personnel the Electric Braking effort of each traction package.
4.8	EP Brake Converter	The TOS shall monitor and display to the authorised personnel the input to and output of EP Brake converters if used.
<b>4.9</b>	<b>Interface to Climate Control System Maintenance</b>	Climate Control Self-Test. The TOS shall display to the authorised personnel the results of the selected climate control unit self test.
<b>4.10</b>	<b>Interface to Traction System Maintenance</b>	
4.11	Traction Auxiliary Contacts	The TOS shall monitor the state of all traction Subsystem auxiliary contacts, identify Faulty auxiliary contacts and display results to authorised personnel.
4.12	Traction Differential Detector	The TOS shall monitor the state of the differential detector, identify Faulty conditions and display results to authorised

		personnel.
4.13	Traction High Voltage Contact Speed	The TOS shall monitor the operational speed of all traction Subsystem high voltage contacts, identify Faulty contacts and display results to authorised personnel.
4.14	Traction High Voltage Contacts	The TOS shall monitor, via indirect means, the state of all high voltage contacts, identify faulty contact states and display the states to the authorised personnel.
<b>4.15</b>	<b>Interface to Auxiliary Power Electrical Maintenance</b>	
4.16	Auxiliary Power Auxiliary Contacts	The TOS shall monitor the state of all Auxiliary Power Supply auxiliary contacts, identify faulty auxiliary contacts and display results to authorised personnel.
4.17	Auxiliary Power Main Reservoir Charging Time	The TOS shall monitor and display to the authorised personnel the time to charge each Main Reservoir from its associated compressor to operating pressure as an indication of compressor condition or existence of leaks.
4.18	Battery Charge	The TOS shall monitor and display to the authorised personnel the state of charge of the Auxiliary Power supply batteries.
4.19	Battery Maintenance	No TOS batteries shall require replacing at intervals more frequently than 5 years.
4.20	Battery Replacement	Level 2 maintenance shall be limited to battery replacement.
<b>4.21</b>	<b>Interface to Auxiliary Power Mechanical Maintenance</b>	
		Compressor Elapsed Operating Life. The TOS shall monitor and display to the authorised personnel the elapsed operating life of the compressor eg. no of cycles or hours of operation
<b>4.22</b>	<b>Interface to Main Power Maintenance</b>	
		High Voltage Contact Speed. The TOS shall monitor, via indirect means, the operating time of all Main Power Supply high voltage contacts, identify faulty contacts and display results to authorised personnel.
<b>4.23</b>	<b>Interface to Lighting maintenance</b>	

		Lighting System Self Test. The TOS shall display to the authorised personnel the results of the selected Lighting System self test.
<b>4.24</b>	<b>Interface to Crew Control Maintenance</b>	
		Crew Control Self Test. The TOS shall display to the authorised personnel the results of the selected Crew Control System self test.
<b>4.25</b>	<b>Interface to Communications Maintenance</b>	
		Communications System Self Test. The TOS shall display to the authorised personnel the results of the selected Communications System self test.
<b>4.26</b>	<b>TOS General Maintenance Requirements</b>	
4.27	Download to Extraction Device	The TOS shall have provision to download information and instruction changes, via a transportable data extraction device, from an IBM compatible Personal Computer.
4.28	Extraction Device Functionality	<p>The data download extraction device shall:</p> <ol style="list-style-type: none"> <li>1. Have the ability to graphically display on-screen any number from one to a minimum of 20 concurrent channels, of which at least 4 of these can display analogue data if required.</li> <li>2. Display a derived, real time acceleration value.</li> <li>3. Have the ability to change the individual colours used to draw each displayed analogue channel.</li> <li>4. Provide an optional grid overlay on displayed analogue data.</li> <li>5. Provide the option to change at any time the data channels to be displayed as well as the order in which they are presented.</li> <li>6. Provide the choice of either absolute or relative values of distance or time displayed for the horizontal x-axis when data is displayed graphically. Relative values shall be measured from a user selected reference point that can be</li> </ol>

		<p>easily changed.</p> <p>7. Provide magnification zoom in and zoom out functions of graphical displays of data.</p> <p>8. Provide in the graphical display mode the choice for each analogue channel of setting the maximum value that can be display</p>	
	4.29	Fault Diagnosis	The TOS shall provide the Crew with relevant Fault diagnostic trace information, and shall identify to authorised personnel the lowest replaceable line unit for all defective equipment.
RFTA 00243	4.30	General Subsystem Interface	The TOS shall monitor all Subsystem protection systems and display to the authorised personnel all activated systems and the <u>likely</u> causes for that activation.
	4.31	Interface to the Set-borne Gateway in Real-time	Interface to the Set-borne Gateway in Real-time. The TOS shall automatically send all recorded information to the Set-borne Gateway in real-time.
	4.32	Interface to PPP Co MMIS Automatically	Interface to PPP Co MMIS automatically. The TOS shall, automatically and/or on demand, send all recorded information to the PPP Co MMIS.
	4.33	Level 2 Diagnostics	Level 2 diagnostic results shall consist of status, Fault information and recommended remedial action required to be undertaken by the authorised personnel to maintain or restore the Set to operational specification in a depot environment.
	4.34	Maintenance	The TOS shall require no maintenance other than replacement of any System batteries, electrolytic capacitors and display unit backlights.
	4.35	Maintenance Access via TOS screen	When the System is in the maintenance mode authorised staff shall be able to access the TOS via the TOS screen in any Crew Cab.
	4.36	Not used	Not used
	4.37	Not used	Not used
	4.38	Not used	Not used

	4.39	Minimum Expected Life	The minimum expected life for any TOS components which deteriorate with time shall be in excess of 5 years except for the display backlight unit which shall be in excess of 3 years.
	4.40	Monitor Auxiliary Contracts	The TOS shall monitor the state of agreed Main Power Supply auxiliary contacts and identify faulty auxiliary contacts.
	4.41	Monitor Net Power	The TOS shall derive, record and display the net power usage to the authorised personnel.
RFTA 00212	4.42	Programmable Recorder or Portable Service Units Function	<p><del>Five Programmable Recorders or PSU's shall be supplied with appropriate software (identical to that used by PPP Co's TLS maintenance personnel) for viewing recorded data. The Programmable Recorder shall be portable by single person. When in use, the Portable Recorder or PSU shall be installed within the Crew Cab. The A Programmable Recorder function shall be provided and shall be able to access all monitored data in the TOS for the purpose of recording selected data.</del></p> <p>The Programmable Recorder <u>function or PSU</u> shall be able to be triggered on any specified selection of monitored data signals. The Programmable Recorder <u>function or PSU</u> shall be able to record any specified signals in detail about a selected time-frame from the trigger point. The Programmable Recorder <u>function or PSU</u> data shall be able to be recorded from 5 minutes prior to the trigger signal until 10 minutes after. <u>The recorded data shall be extractable by PSU into a non-proprietary data format.</u></p>
	4.43	Real Time Calibration	Real time calibration adjustment by software of the ER shall be possible via a plug in a lap top computer.
	4.44	Recall Diagnostic Results	Authorised staff shall be able to recall for display any diagnostic results recorded.
	4.45	Search Diagnostic Result Categories	Authorised staff shall be able to search diagnostic results in categories based on individual Subsystems.
	4.46	Search Diagnostic Results	Authorised staff shall be able to search through all diagnostic results chronologically in both directions i.e. newest to oldest and oldest to newest.
	4.47	Sort Diagnostic Results	Diagnostic results shall be able to be sorted according to the Subsystems.
	4.48	Upload Records	The TOS data records shall be sent in a format compatible with the requirements of the RailCorp MMIS.
	4.49	Upload to Extraction Device	The TOS shall have provision to upload information to the transportable data extraction device and thence to an IBM compatible Personal Computer for further analysis.

--	--	--



## TOS Alarm List

5.1	Alarm List Screen	The TOS shall allow the Set Crew to access the alarm list from any screen. The alarm list screen shall provide access to the alarm log and the text message log. The list shall display all current alarms in chronological order with the most recent at the top. The TOS screen shall also be capable of displaying and downloading all current alarms and all alarms that have been cleared by train crew action in the previous 24 hour period.
5.2	Alarm Sort	The TOS shall allow the Set Crew to re-order the displayed list of alarms in Fault code order with the most safety critical Fault (lowest Fault code) presented at the top of the screen.
5.3	Alarm and Fault Reset	Both the Driver and Guard shall have the same access to the reset functions for the following systems: - Doors; - HVAC; and - Communications
5.4	Alarm List	The following alarms are to be included in the TOS and directed to the Driver via the TOS screen. Those alarms that are also directed to the Guard are stated.
		Air bag flat
		Air compressor failed
		HVAC circuit breaker tripped
		Auxiliary power supply inverter failed
		Brake air pressure Fault [also directed to Guard]
		Brake Dragging
		Cab door/window open Wash Mode
		Cab door Driver side failed [also directed to Guard]
		Cab door Guard side failed [also directed to Guard]
		Cab door open above set speed [also directed to Guard]
		Cab security breached – Crew side door [also directed to Guard]
		Cab security failed breached – transverse or detrainment door
		Circuit breaker tripped – coupler
		Circuit Breaker tripped – fresh air [also directed to Guard]
		Communications controller failed [also directed to Guard]
		Control battery charger failed
		Cooling System failed [also directed to Guard]
		Crew intercom failed [also directed to Guard]
		Data radio control failed [also directed to Guard]
		Data radio link to CCU failed
		Digital Voice Annunciator mal-operation [also directed to Guard]

		Doors 1-3 failed (motor and trailer) [also directed to Guard]
		Doors 2-4 failed (motor and trailer) [also directed to Guard]
		Doors 5-7 failed (motor and trailer) [also directed to Guard]
		Doors 6-8 failed (motor and trailer) [also directed to Guard]
		DVA or PA failed [also directed to Guard]
		Emergency fresh air failed [also directed to Guard]
		EP Brake control failed
		Event Recorder failed [also directed to Guard]
		Event Recorder failed calibration test
		Headlight or foglight failed
		Heating System failed [also directed to Guard]
		Horn circuit breaker tripped
		Intercar door failed to lock for Nightsafe [also directed to Guard]
		Lighting battery charger failed [also directed to Guard]
		Lighting failure [also directed to Guard]
		Operator Enable System failed [also direct to Guard]
		Pantograph air supply failed
		Park brake not responding to command [also directed to Guard]
		Passenger Emergency Intercom failed [also directed to Guard]
		Smoke detected [also directed to Guard]
		Subsystem data link failed
		Surveillance control unit failed [also directed to Guard]
		TOS data link failed
		Traction 50 Hz detected
		Traction inverter failed
		Traction voltage above maximum
		Traction voltage below minimum
		Train not on correct route [also directed to Guard]
		Vigilance System circuit breaker tripped [also directed to Guard]
	5.5	Alarm Bar Location The display of alarms on the main status screens is to overwrite the title as shown in Appendix M, item 4.
RFTA	5.6	Alarm Bar Overwriting The alarms shall be displayed to the Crew <u>based firstly on priority and then within each priority on the basis of time received (i.e. first in first out)</u> . The highest priority alarm shall be displayed until acknowledged or cleared. Other alarms shall be queued until the displayed alarm is

00210			cleared and then the next alarm shall be displayed based on priority and then based on first in first out within each priority, immediately on occurrence with the latest incoming alarm overwriting the previous bar. The only exception to this is the fire and smoke alarm, which shall not be fully overwritten.
	5.7	Alarm Bar Division	The fire and smoke alarm shall have two elements that shall display in the alarm panel. A smaller section shall be shown to the right of the main message and this shall not be overwritten by other alarm messages.
	5.8	Cab Door and Air Suspension Alarms	<p>A "Cab door open" warning shall be shown to the Crew above 70 km/hr if a cab door is open.</p> <p>An "air bag deflated" warning shall be shown to the Crew if an air bag becomes deflated. The warning shall include an indication of the maximum safe operating speed in the deflated condition.</p> <p>These two alarms shall be in a similar format to the smoke alarm with the main text in the large portion, and being overwritten by subsequent alarms, and the speed limit shown on the right and overwritten only by a lower speed limit or a smoke alarm signal.</p>
	5.9	Alarm Scheme Development	<p>All details of alarms shall be developed by PPP Co from the requirements in this RailCorp Train Performance Specification to provide an alarm scheme that is appropriate to the PPP Set in its operating context, the scheme shall include consideration of which crew member should be alerted by each alarm and the reset method. For common alarms means shall be provided to demonstrate to both crew that the alarm has been reset if this is done by the other crew member.</p> <p>The lists of alarms provided shall be reviewed as part of the design development process and any new alarms found necessary to mitigate failures and consequent operating problems shall be included. The PPP Co shall satisfy itself and RailCorp that the alarm list includes only alarms appropriate to the design of the Set.</p>

## **APPENDIX L – TRAIN OPERATING SYSTEM HIERARCHY**

The navigation route between the screens and the respective modes of operation of the TOS screen is defined in Figures 1 and 2.

To fully understand the overall TOS Screen functional requirements, the diagram should be used in conjunction with the information provided in Appendix M – TOS User Interface Screens.

Figure 1 – TOS Screen Hierarchy - Driver

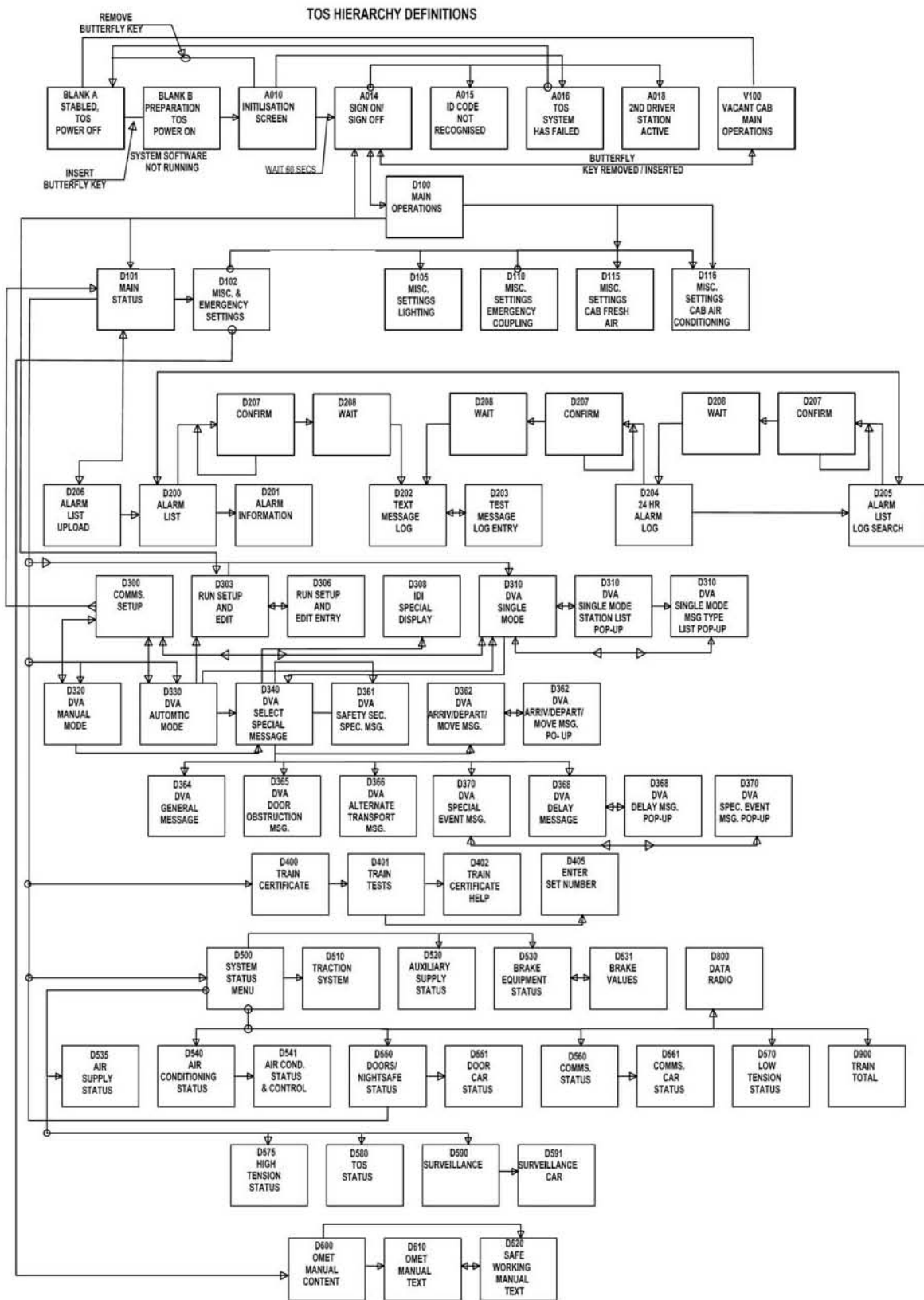


Figure 2 – TOS Screen Hierarchy – Guard

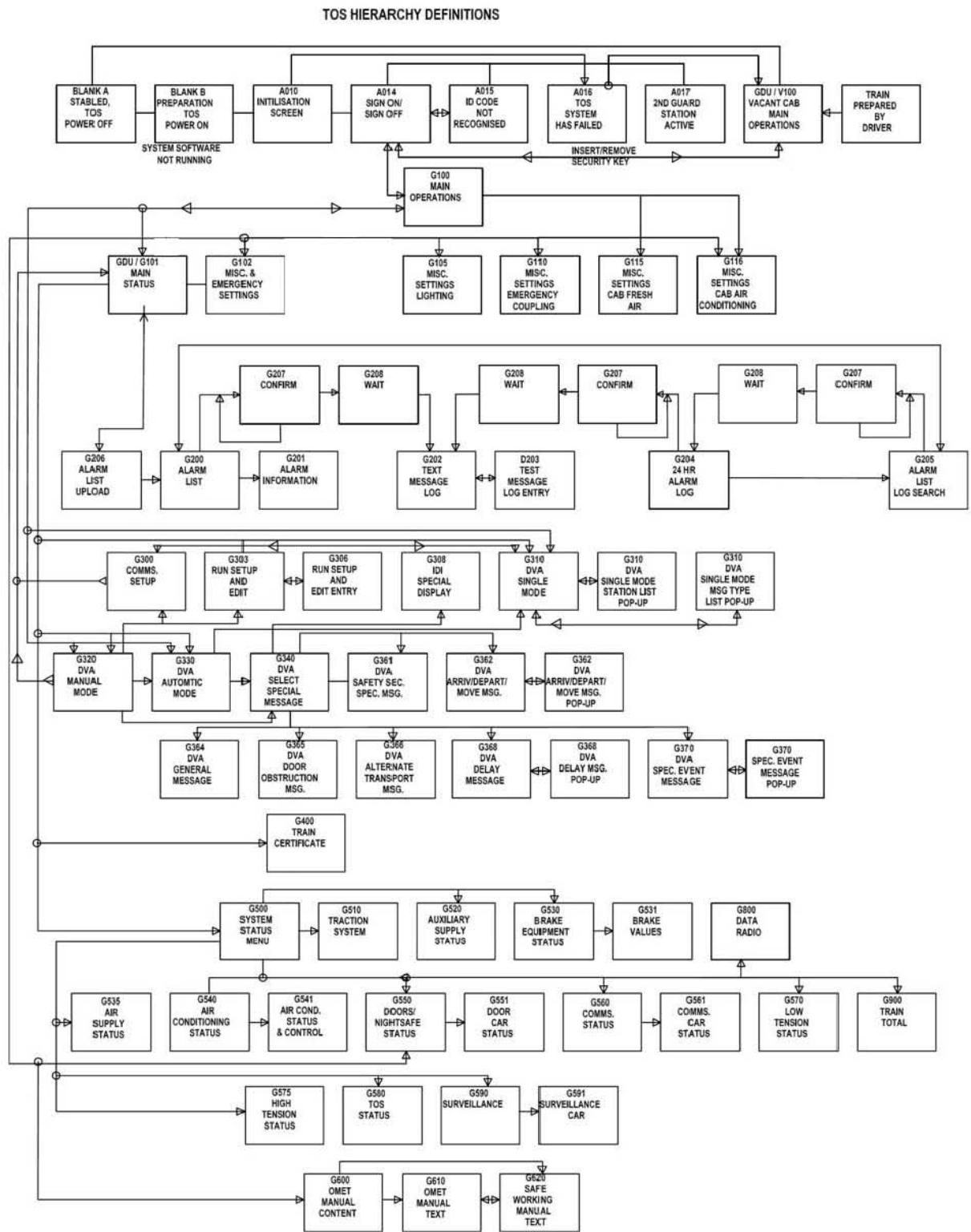


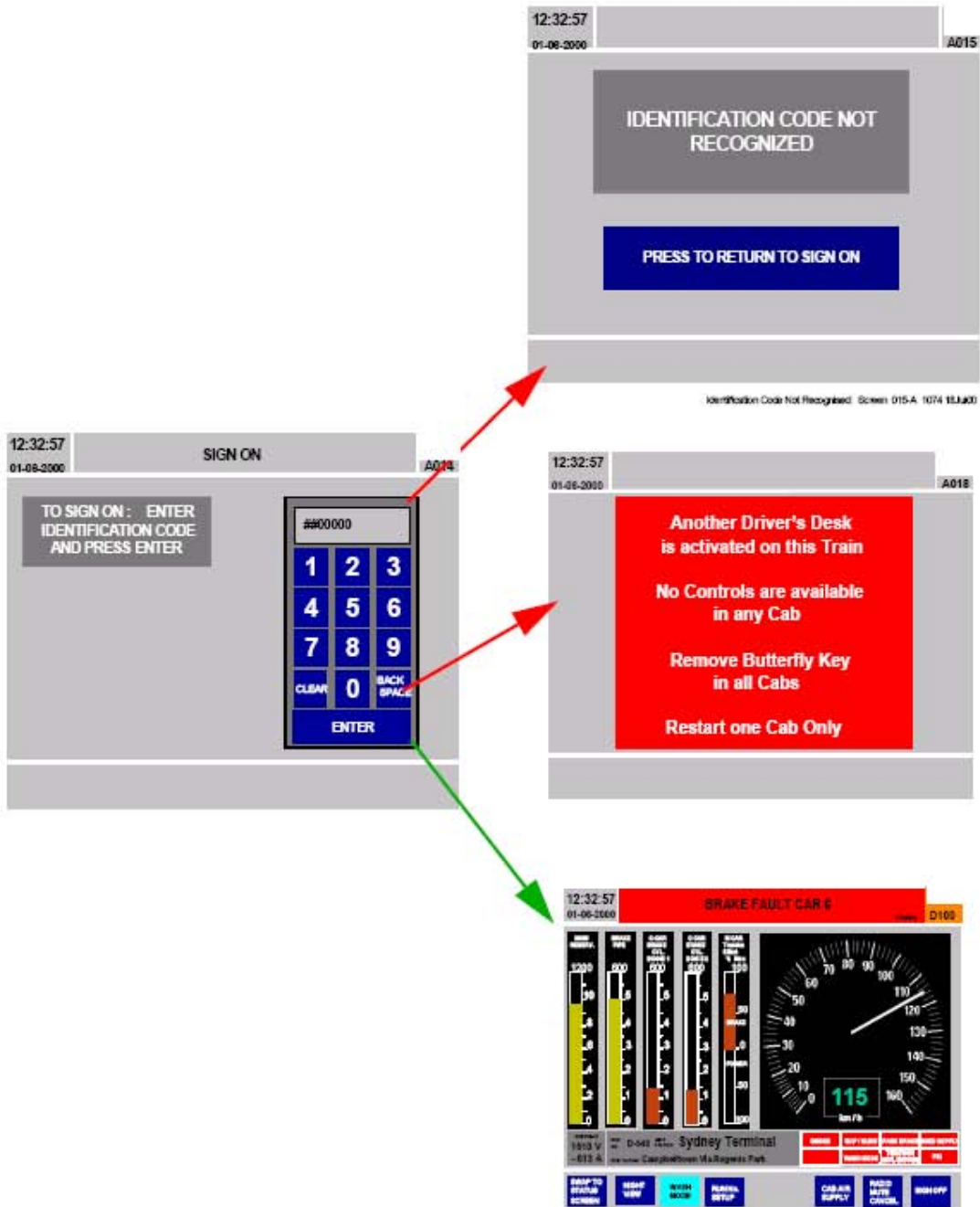
Figure X.

## APPENDIX M - TOS USER INTERFACE SCREENS

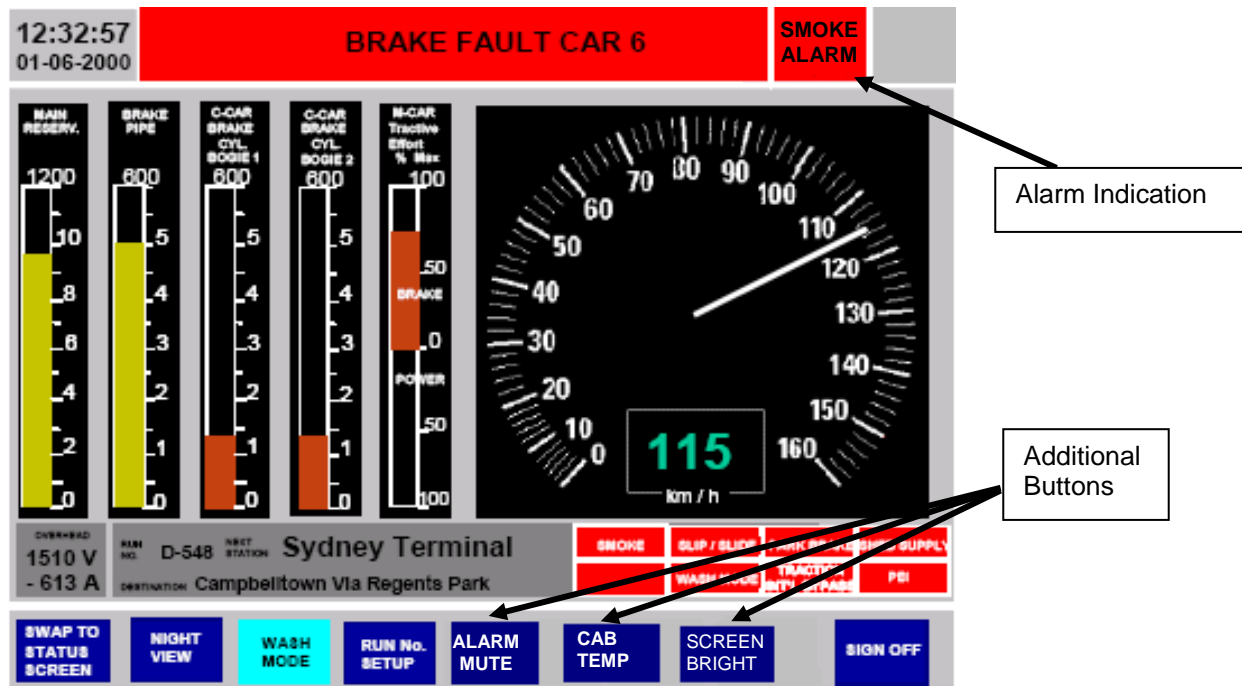
**Note:** TOS screen design to be subject to development during design stage. Images are indicative of requirements.

### 1. Crew Sign-On Screen

Sign on screen with crew identification number required.



## 2. Main Operations Screen (D)river – Screen D100



### NOTE

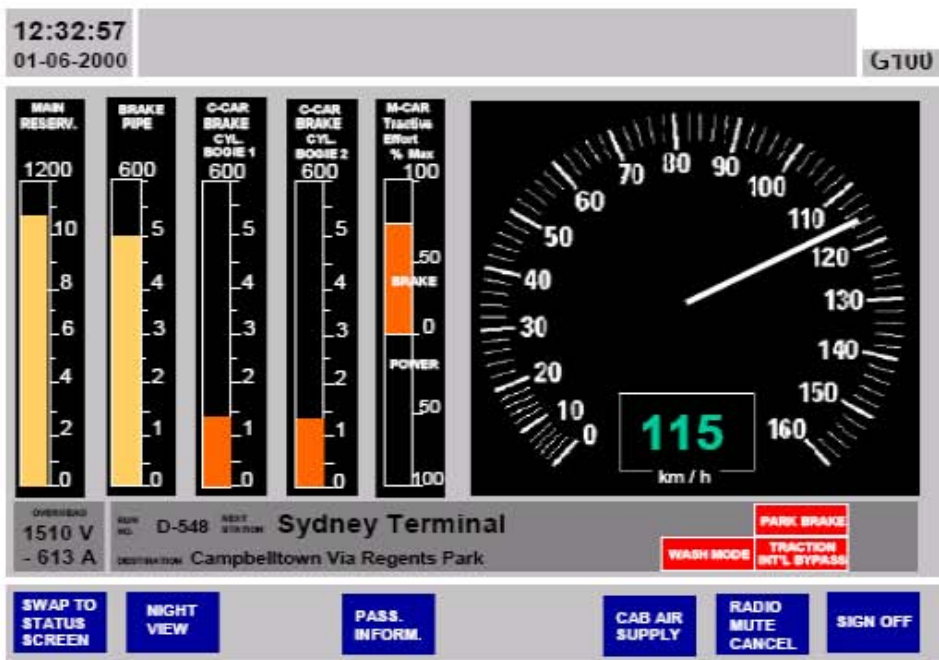
The additional buttons to be added are to enable pop-up menus for cab temp, screen brightness and alarm mute. This has allowed Radio Mute call Cancel and the Cab air supply button to be deleted.

See Number 45 for pop up menus displays.

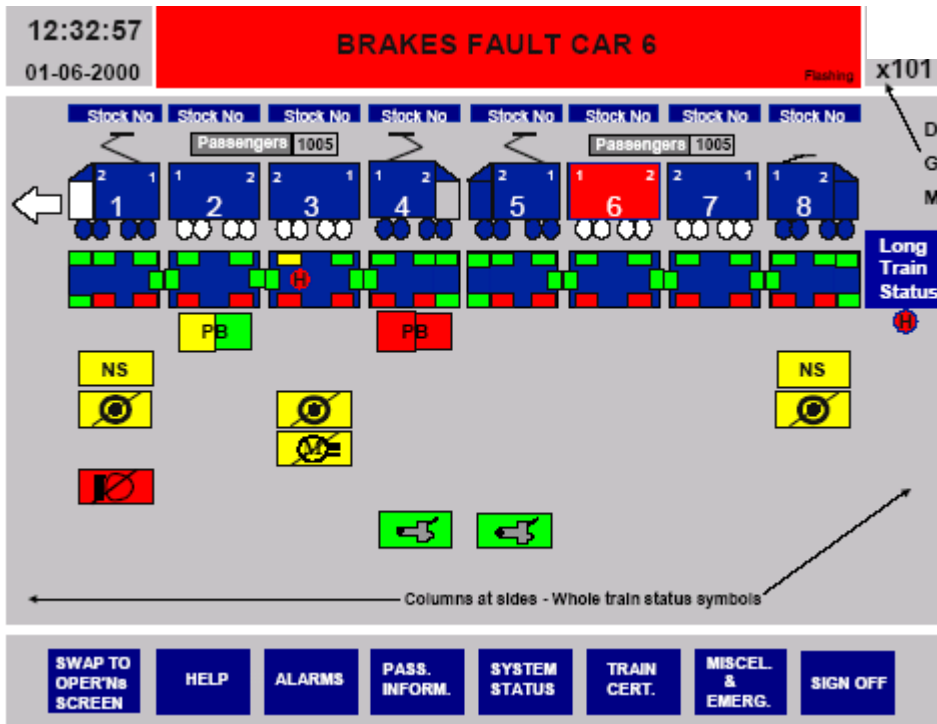
At the top right hand corner of the Alarm Bar (currently displaying Brake Fault Car 6) there shall be dedicated area to display three alarms. These are Smoke Alarm (as shown), Flat Air Bag 80km/h and Crew Door Open 70km/h. When alarm is activated, the location of the alarm area should appear in every TOS Screen.



### 3. Main Operations Screen (G)uard – Screen G100



4. Main Status – Screen x101













NOTE

This screen shows the main status screen for Park Brake, Nightsafe, Brakes Isolated, Traction Motor Isolated, headlight Beam failure and Coupler Coupled. The status screen for the PPP project shall show information on the following systems: Park Brake, Nightsafe, Brake Isolation, Traction status, Headlight High Beam, Event Recorder and Trip Gear on same line, Fire Smoke Detectors. See Number 43 for TOS Night screen.

If the headlight beam has failed, then the symbol for the headlight shall be presented in red. Otherwise, it will be green when turned on and operating correctly and no indication shall be provided when it is turned off.

## 5. Definition of Symbols

SYMBOL	DESCRIPTION
	Coupler Coupled
	Coupler Fault
	Brake Isolated
	Park Brake Both Bogies Applied
	Park Brake Both Bogies Released
	Park Brake Both Bogies Isolated
	Park Brake one Bogie Released, other Applied
	Night Safe
	Headlight High Beam Fail
	Traction Motor Isolated

## 6. Alarm Screen (D-G-M) – Screen x200

The screenshot displays the Alarm Screen (D-G-M) with the following information:

Time: 12:32:57  
Date: 01-06-2000  
Location: D200

Code	Alarm Description	Code	Time	Value
6XXXX	BRAKE FAULT /line 2	M-0001	12:37:45	31.5.99
1XXXX	AIR CONDITIONING FAULT /line 2	T-0001	11:37:45	30.5.99

Navigation and Action Buttons:

- TEXT MESSAGE LOG
- 24 HOUR ALARM LOG
- SUB SYSTEM SORT
- ALARM SEARCH
- PAGE UP
- PAGE DOWN

Bottom Menu Bar:

- HELP
- ALARMS (highlighted)
- PASS. INFORM.
- SYSTEM STATUS
- TRAIN CERT.
- MISCEL. & ENERG.
- MAIN SCREENS

Other alarm related information can be accessed via this screen by use of the following navigation keys:

- Text Message Log
- 24 Hour Alarm Log
- Alarm List Log Search

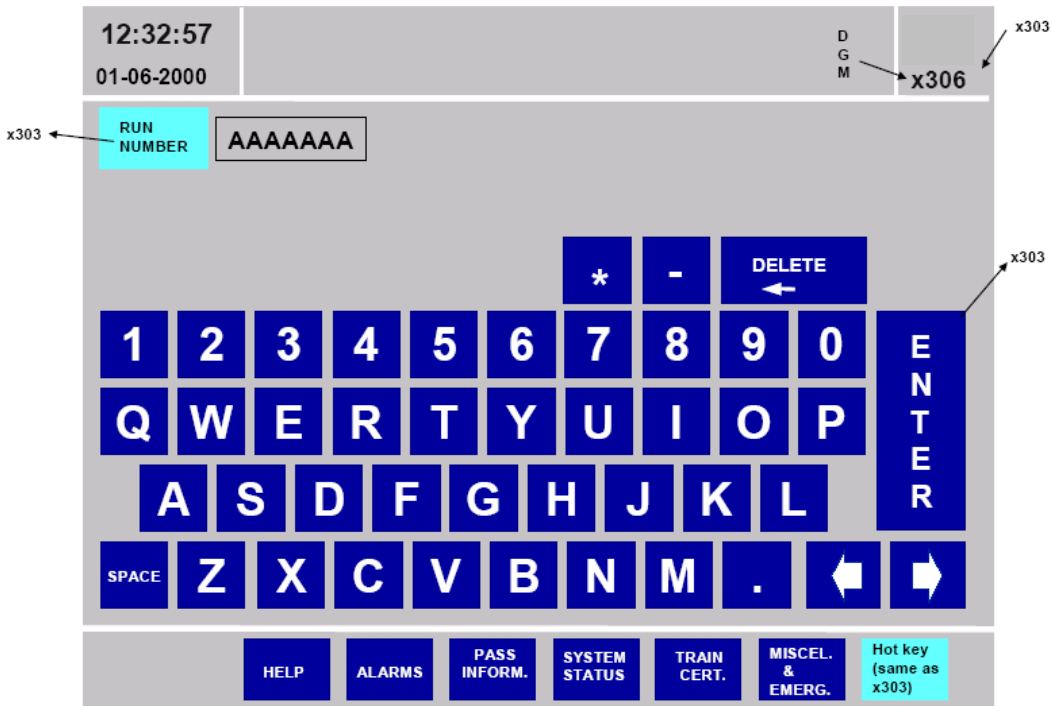
## 7. Run Setup (D-G-M) – Screen x303

This screen provides access to the Train Destination Run information.

## 8. Run List Edit – Screen x304

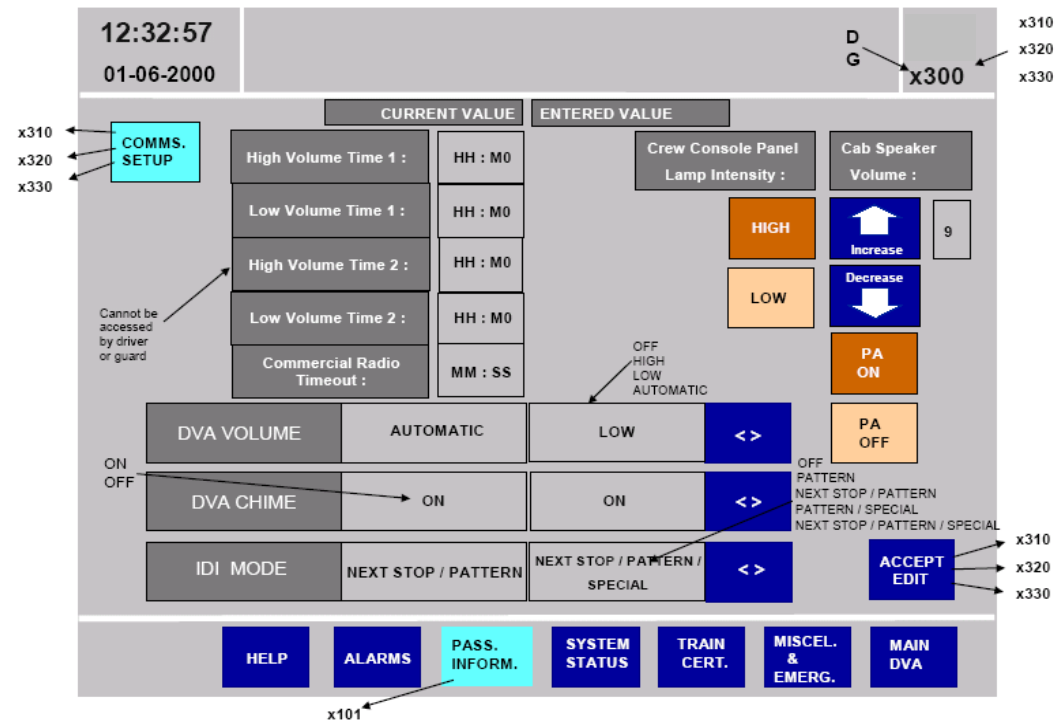
The Run List Edit screen enables the operator to manually set up the run starting point and edit and stations out of the designated run.

## 9. Run Setup Entry



## 10. Communications Screen Setup – Screen D300

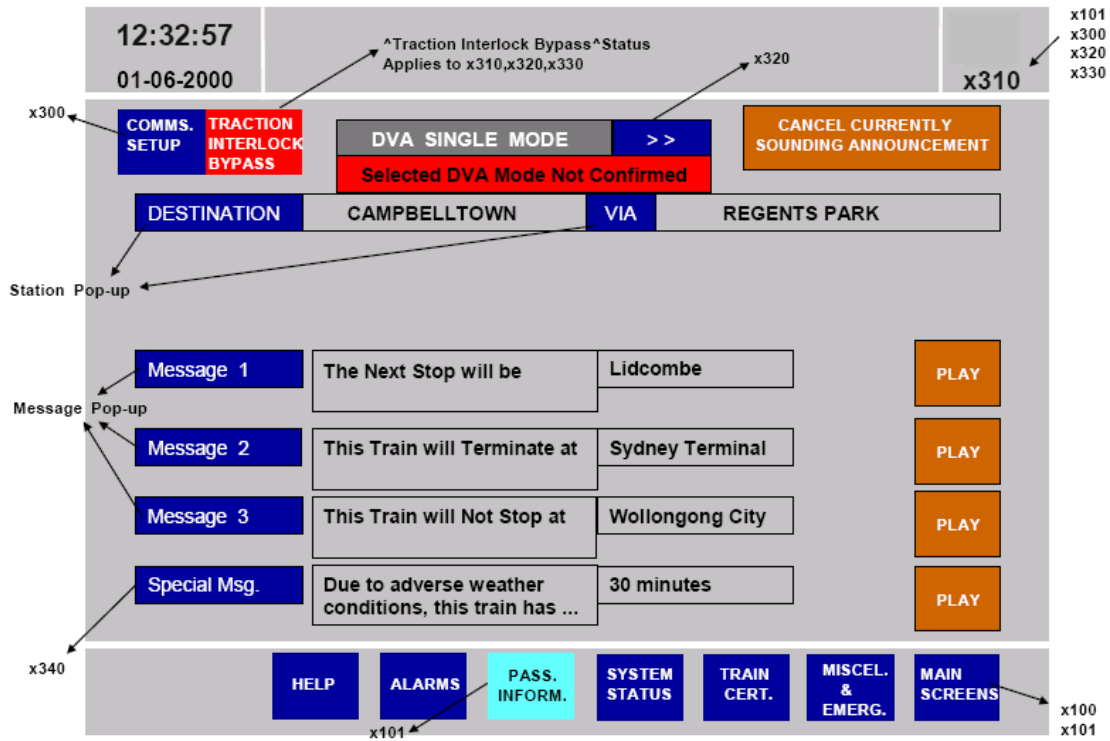
Primary screen accessed to set up all of the trains communication functions.



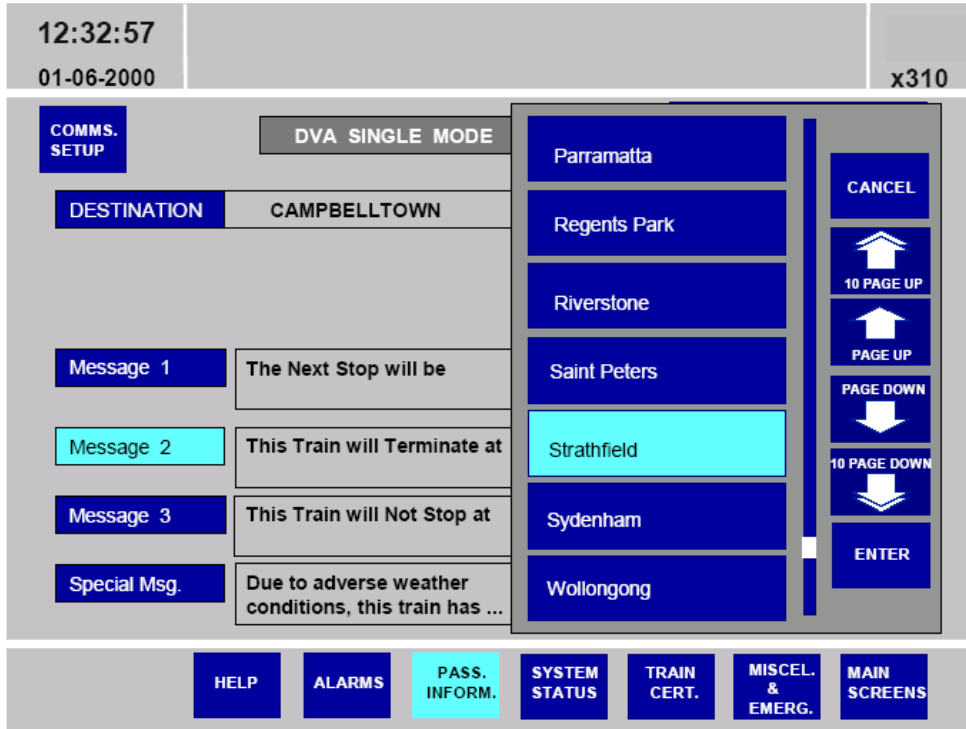
The communications features include:

- Communications setup;
- Cab speaker volume;
- Crew console panel lighting intensity;
- DVA volume and chime application;
- Internal Destination Indicator Mode of operation; and
- PA ON/OFF

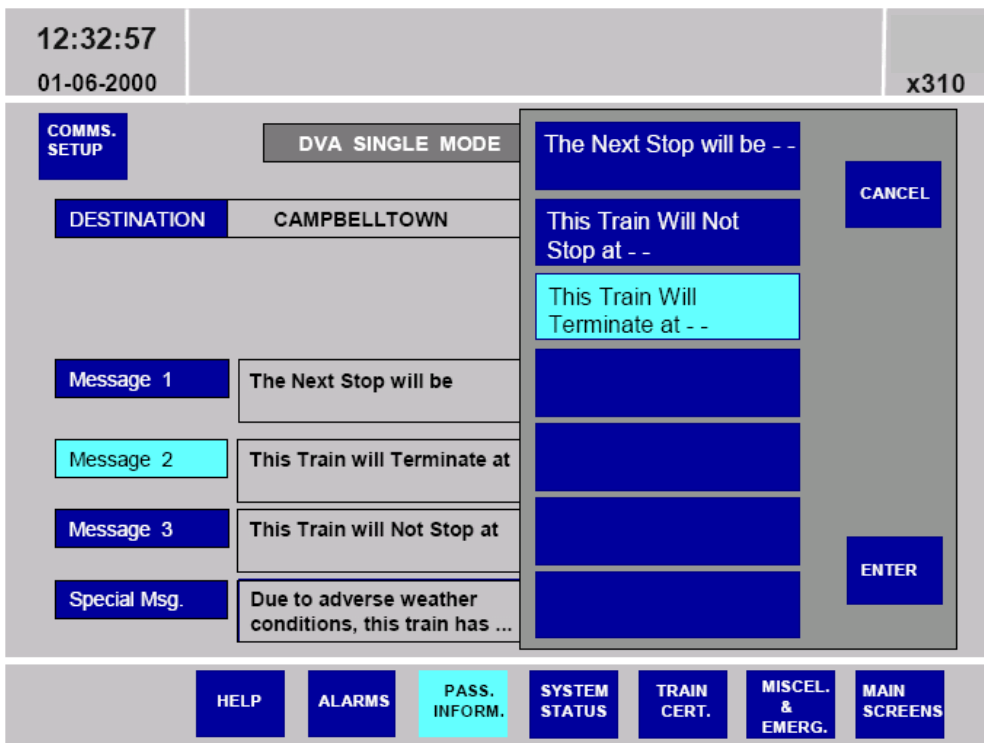
### 11. DVA Single Mode – Screen G310



### 12. DVA Single Mode Station List Pop-up – Screen D310

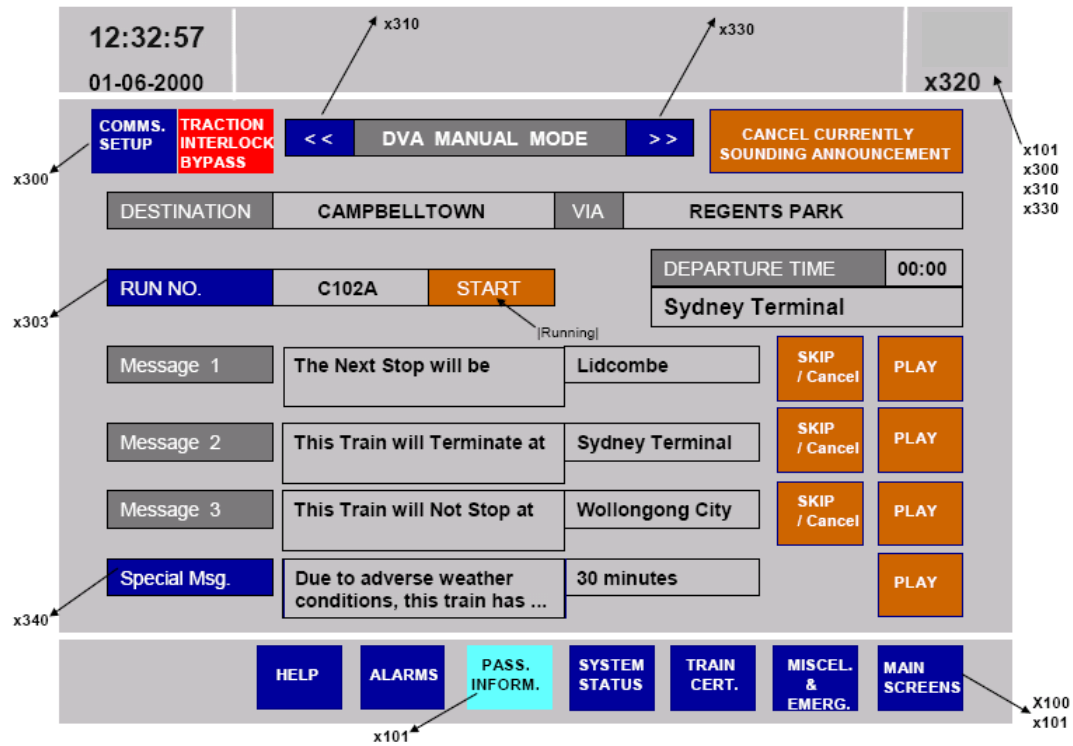


13. Single Mode Message Type List Pop-up –Screen D310 (D-G-M)

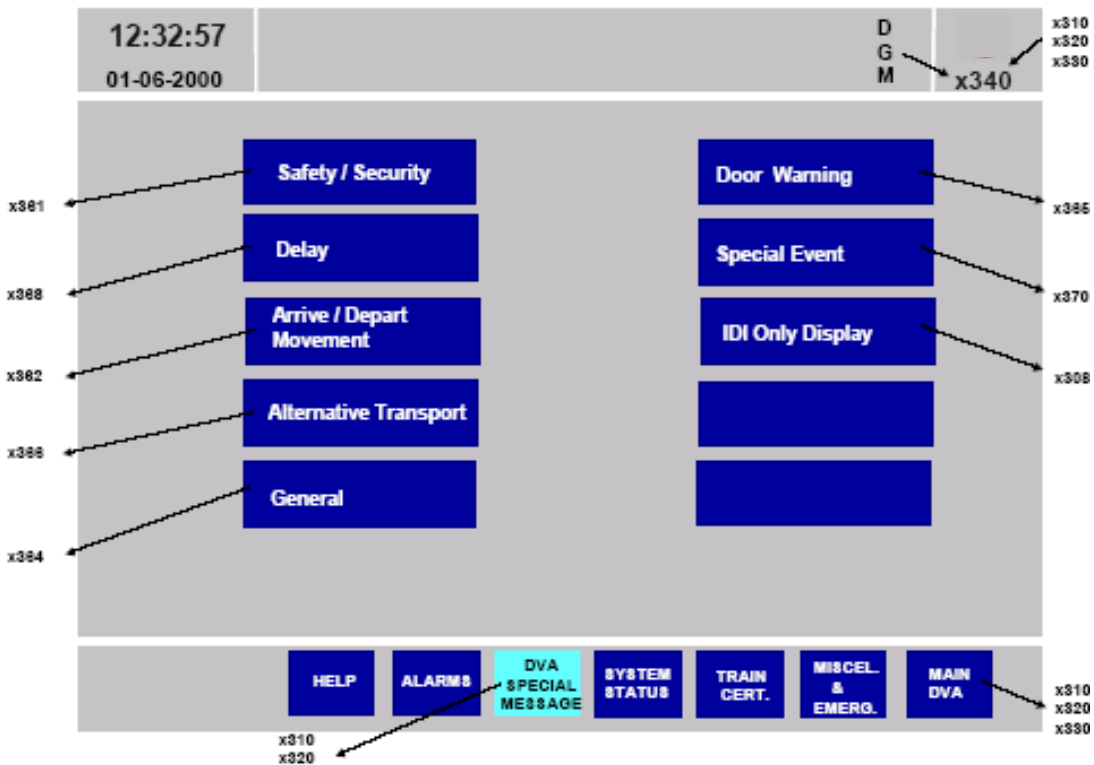




14. DVA Manual Mode – Screen G320

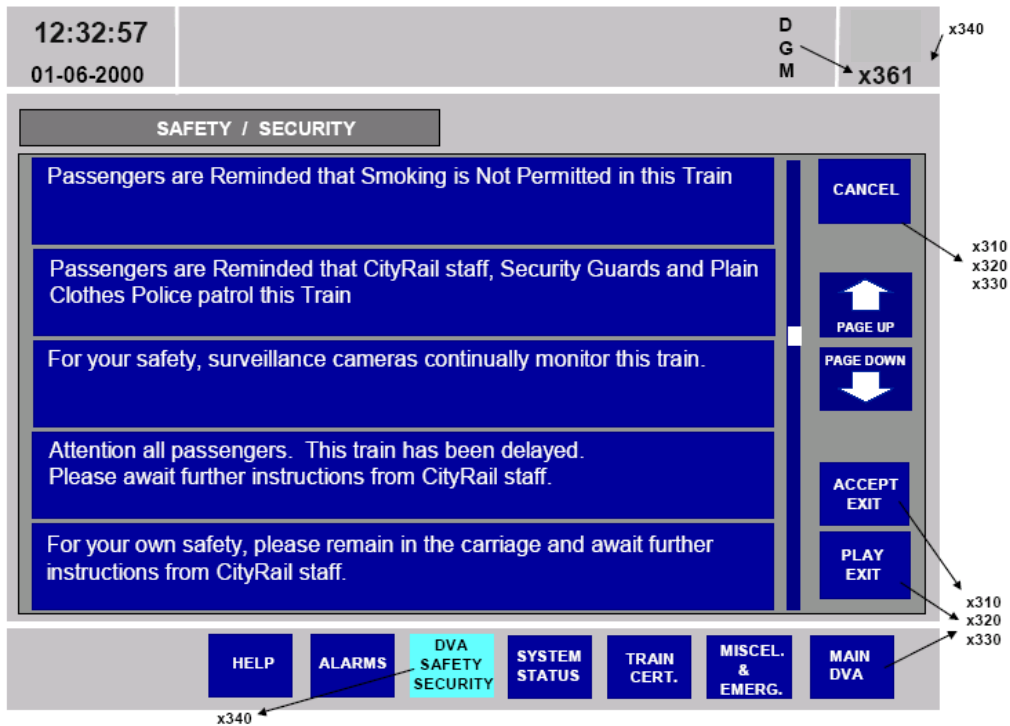


15. Select Special message – Screen D340

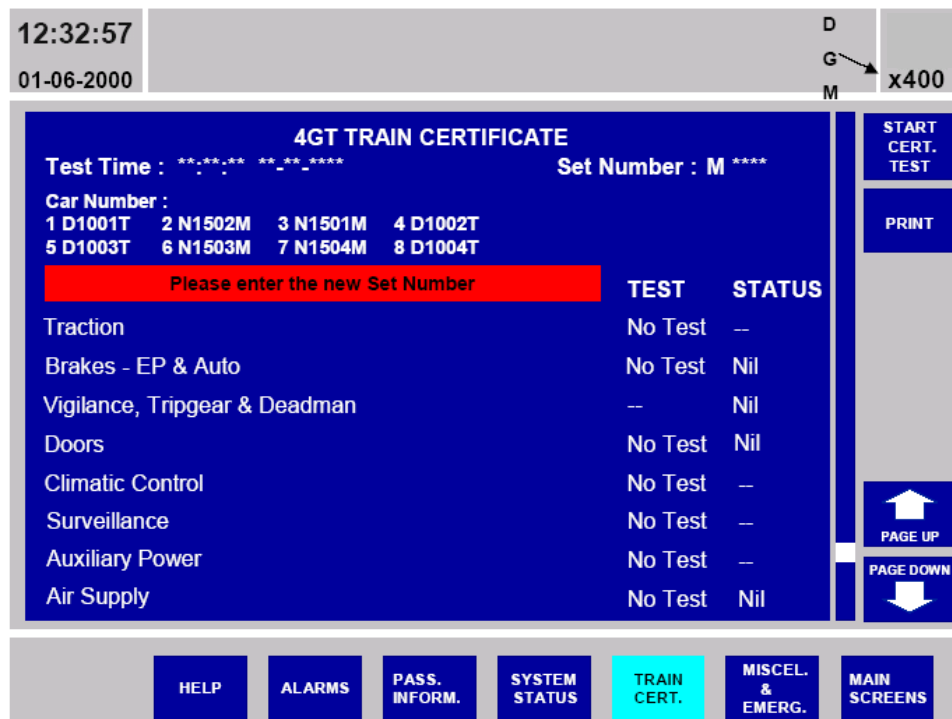


16. Safety/Security Special Message – Screen D360

This screen is used to list the Safety/Security message options. Any of the options can be selected by scrolling through the list and highlighting the relevant message.



### 17. Train Certificate – Screen D400



### 18. Traction Tests – Screen D401a (D-M)

12:32:57 01-06-2000 D M x401

**AUTOMATIC TESTS & SYSTEM STATUS CHECKS : Set : M 1234**

TRACTION	TEST START	TEST DEFECT	
BRAKES - EP & Auto ( Brakes Status D530 & D531 )	TEST CANCEL	TEST IN PROGRESS	NIL
VIGILANCE, DEADMAN & TRIPGEAR ( Brakes Status D530 )			STATUS DEFECT
DOORS ( Doors Status D550 & D551 )	TEST START	NOT TESTED	STATUS OK
CLIMATIC CONTROL	TEST CANCEL	TEST ABORTED	
SURVEILLANCE	TEST START	TEST PASS	

STOP CERT. TEST  
ACCEPT CERT. TEST  
ENTER SET NUMBER  
PAGE UP  
PAGE DOWN

HELP ALARMS PASS. INFORM. SYSTEM STATUS TRAIN CERT. TESTS MISCEL. & EMERG. MAIN SCREENS

19. Train Tests – Screen D402a (D-G-M)

12:32:57 01-06-2000 D M x402

**Train Certificate: HELP**

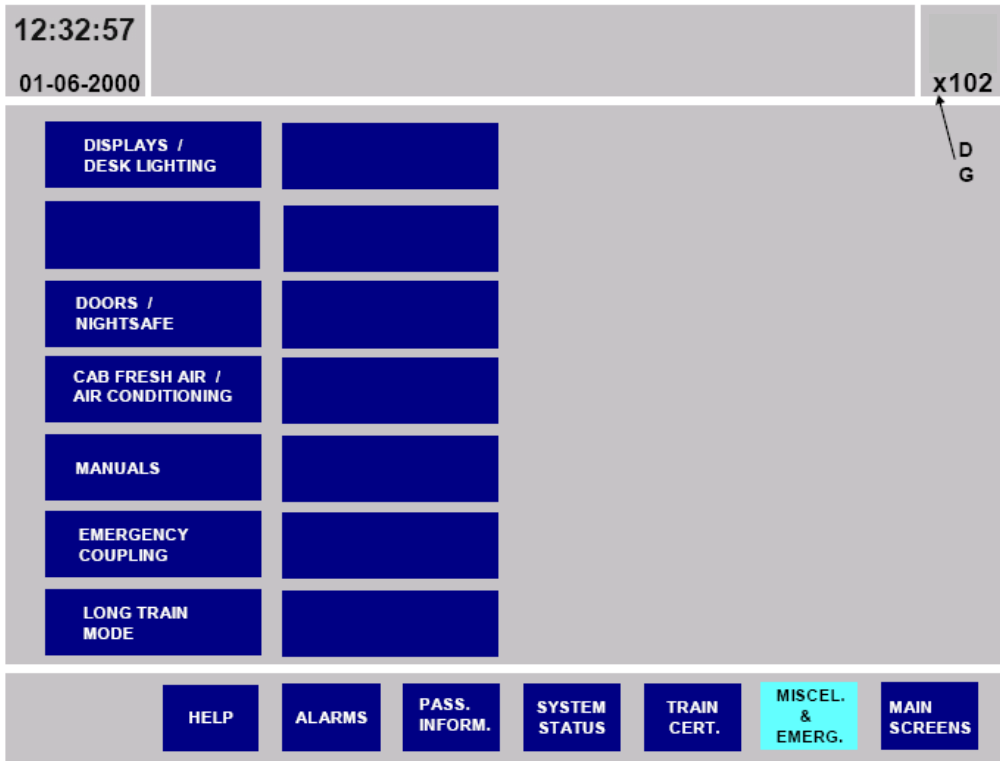
**TRACTION TEST**  
Ensure that the Park Brakes are On and the Combined Controller is in Max Brake.  
Select the [Test Button] to request all traction inverters in the trainset to initiate internal testing of the traction inverter and traction motors.  
Each Traction Inverter will report the result of its tests to the TOS and the TOS will assess whether or not the number of acceptable Traction Inverters available is sufficient to operate that trainset in service.  
Test Result  
Pass Sufficient traction is available to operate this trainset in service.  
Defect There is insufficient traction available to operate in service.

**TRACTION STATUS**  
If desired, the test result for all Traction Inverters on the trainset can be viewed on the Traction Status screen, D510, accessed via the standard links from the System Status navigation key in the toolbar.

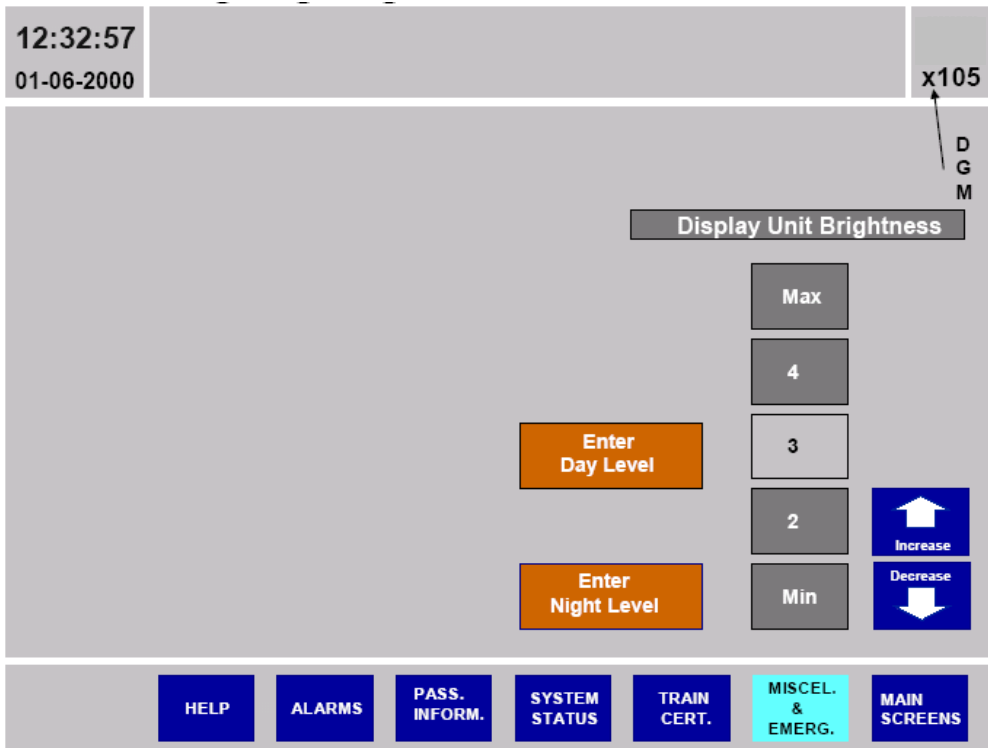
PAGE UP  
PAGE DOWN

HELP ALARMS PASS. INFORM. SYSTEM STATUS TRAIN CERT. MISCEL. & EMERG. MAIN SCREENS

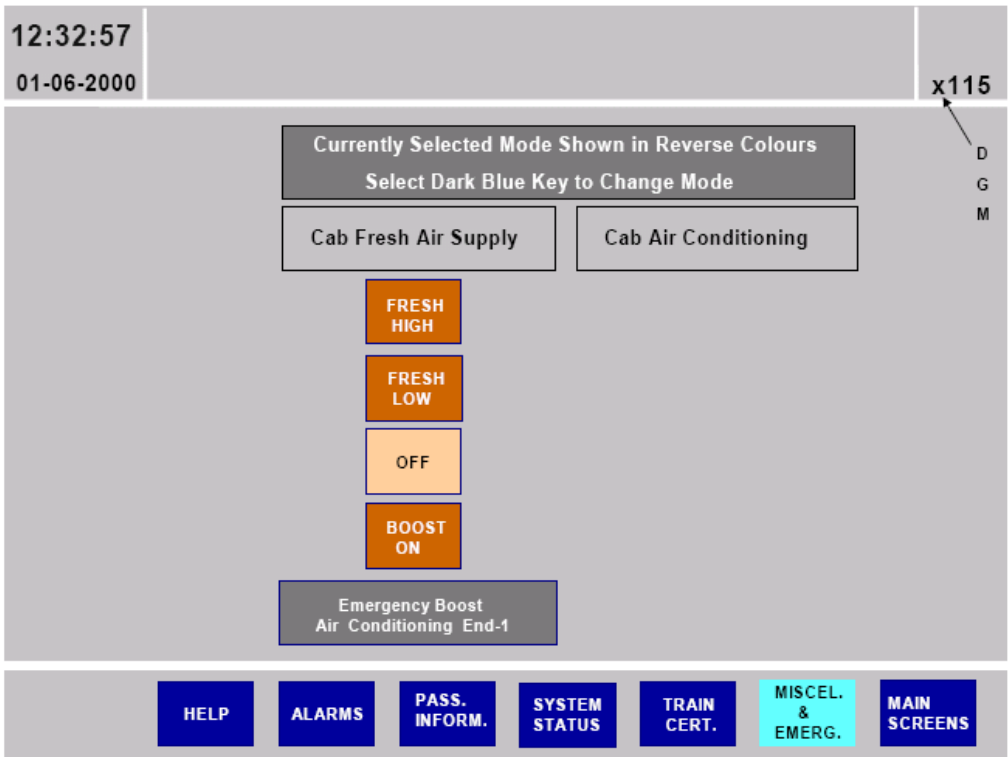
20. Miscellaneous and Emergency Screen Settings



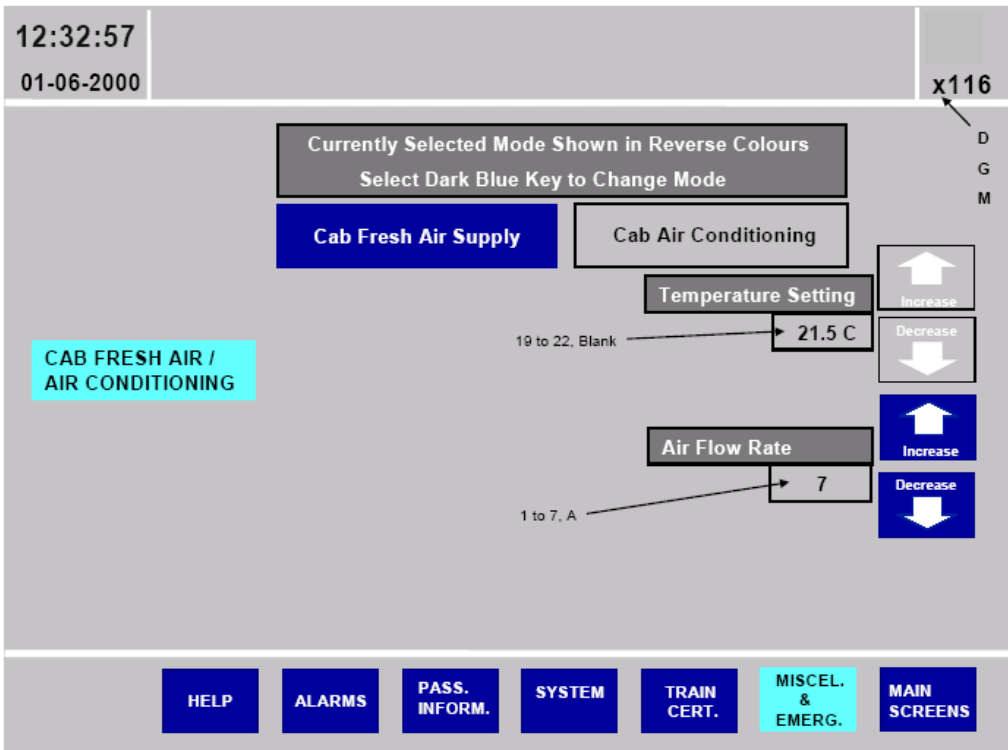
21. Miscellaneous Settings Lighting – Screen D105



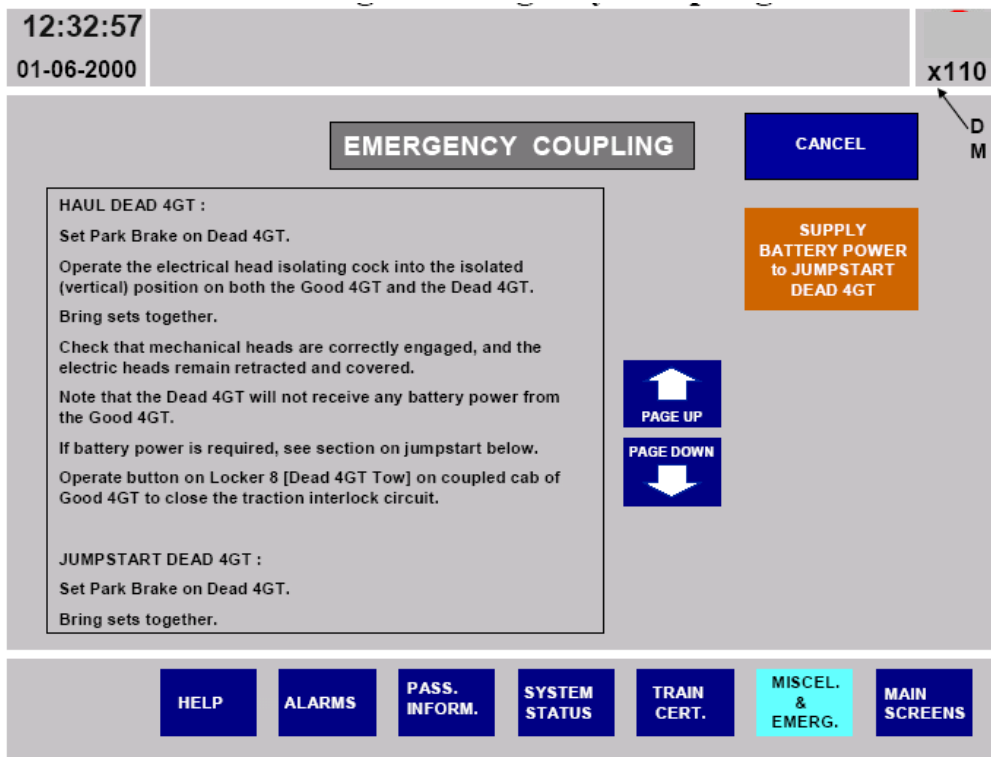
22. Miscellaneous Settings – Cab Fresh Air – Screen D115B (D-G-M)



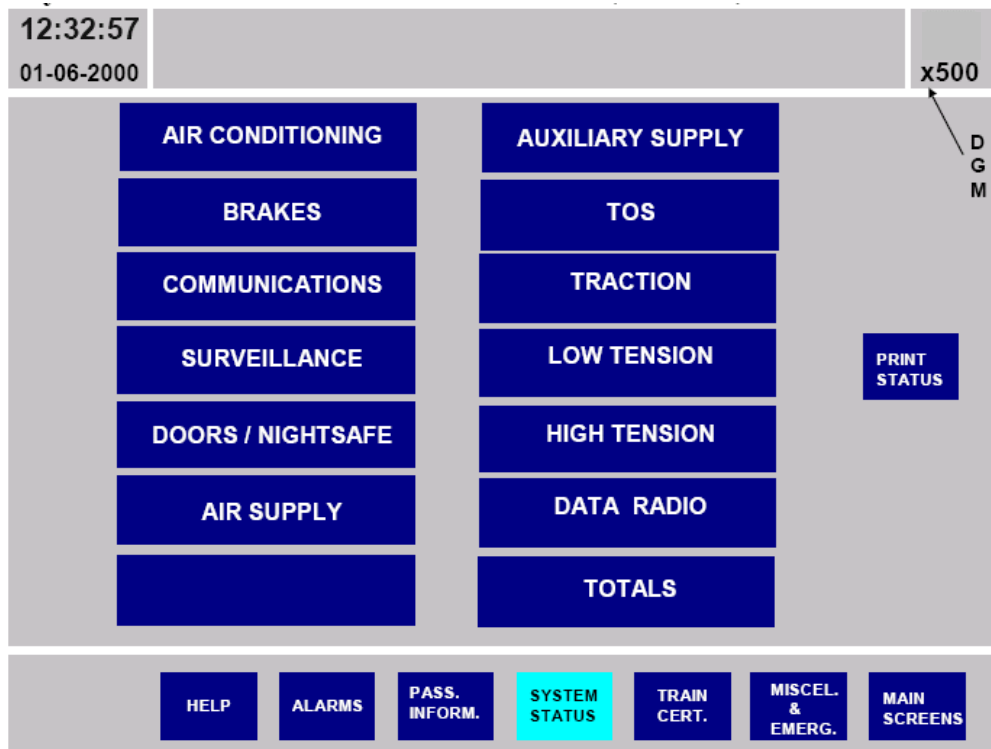
**23. Miscellaneous Settings – Cab Air Conditioning – Screen D116 (D-G-M)**



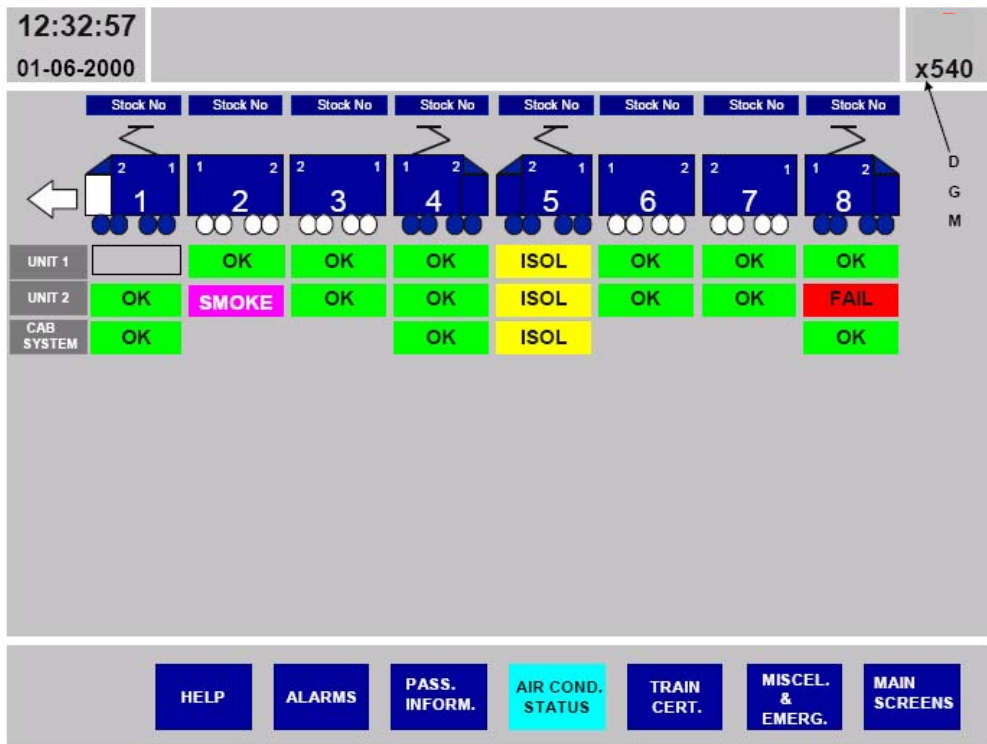
**24. Miscellaneous Settings – Emergency Coupling – Screen D110 (D-M)**



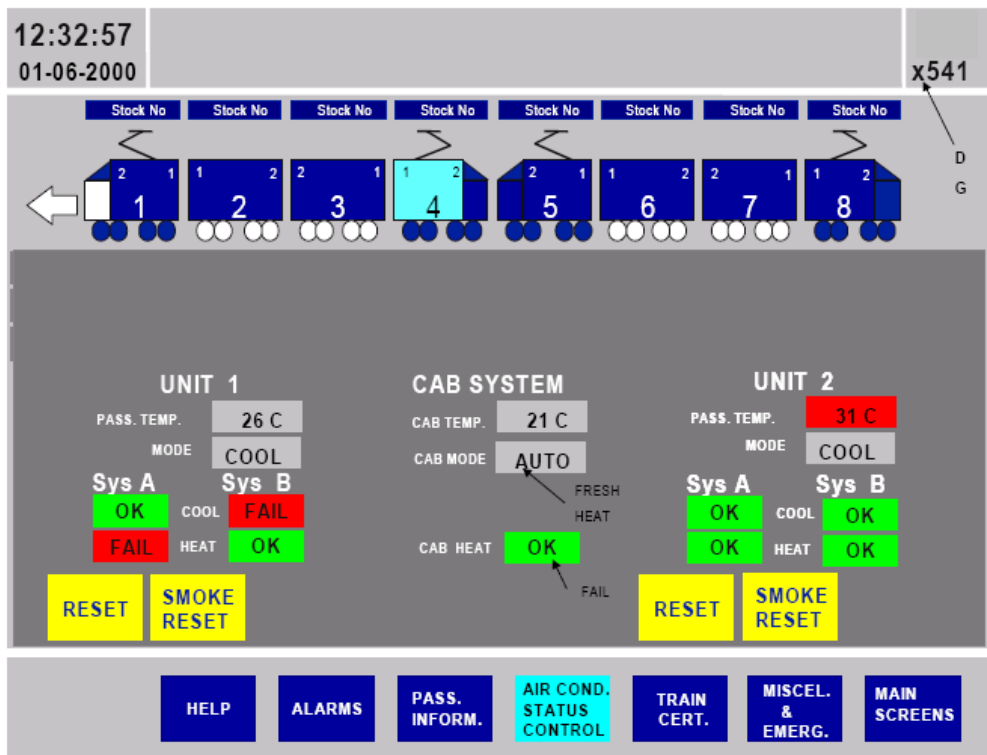
**25. System Status Menu – Screen D500 (D-G-M)**



**26. Air Conditioning Status – Screen D540 (D-G-M)**



27. Air Conditioning Status / Control – Screen D541a (D-G)



28. Brake Equipment Status – Screen D530a (D-G-M)

12:32:57  
01-06-2000

x530

	Stock No	Stock No	Stock No	Stock No	Stock No	Stock No	Stock No	Stock No
BRAKE MODE	AUTO				EP	EP		
CONTROL UNIT	OK	OK	OK	OK		FAIL	OK	OK
WHEEL SLIDE	OK	OK	OK	FAIL	OK		OK	OK
PARK BRAKE 1	OK	OK	OK	OK	ISOL		OK	OK
PARK BRAKE 2	OK	OK	OK	OK	ISOL		OK	OK
TRIP COCK SAI No.1	ISOL			OK				OK
TRIP COCK POSITION	UP			DOWN	UP			UP
BOGIE 1 BRAKES	OK	OK	OK	OK	ISOL		OK	OK
BOGIE 2 BRAKES	OK	OK	OK	OK	ISOL		OK	OK
VIG UNIT	ISOL			OK	OK		OK	OK

D  
G  
M

BRAKES VALUES

HELP ALARMS PASS. INFORM. BRAKES EQUIP'T STATUS TRAIN CERT. MISCEL. & EMERG. MAIN SCREENS

29. Brake Values – Screen D531a (D-G)

12:32:57  
01-06-2000

x531

	Stock No	Stock No	Stock No	Stock No	Stock No	Stock No	Stock No	Stock No
BRAKE MODE	AUTO				EP	EP		
MAIN RESERV.	758			758	988			604
BRAKE PIPE	381			378	376			372
BCP 1	260	260	261	260	263		264	200
BCP 2	Tx FAIL	0	259	258	264		266	202
SPEED ANALOG	111	111	111	112	114	114	114	114
SPEED SERIAL	112	112	112	111	113	113	113	Fault
SPEED E. R.		111	111			114	114	

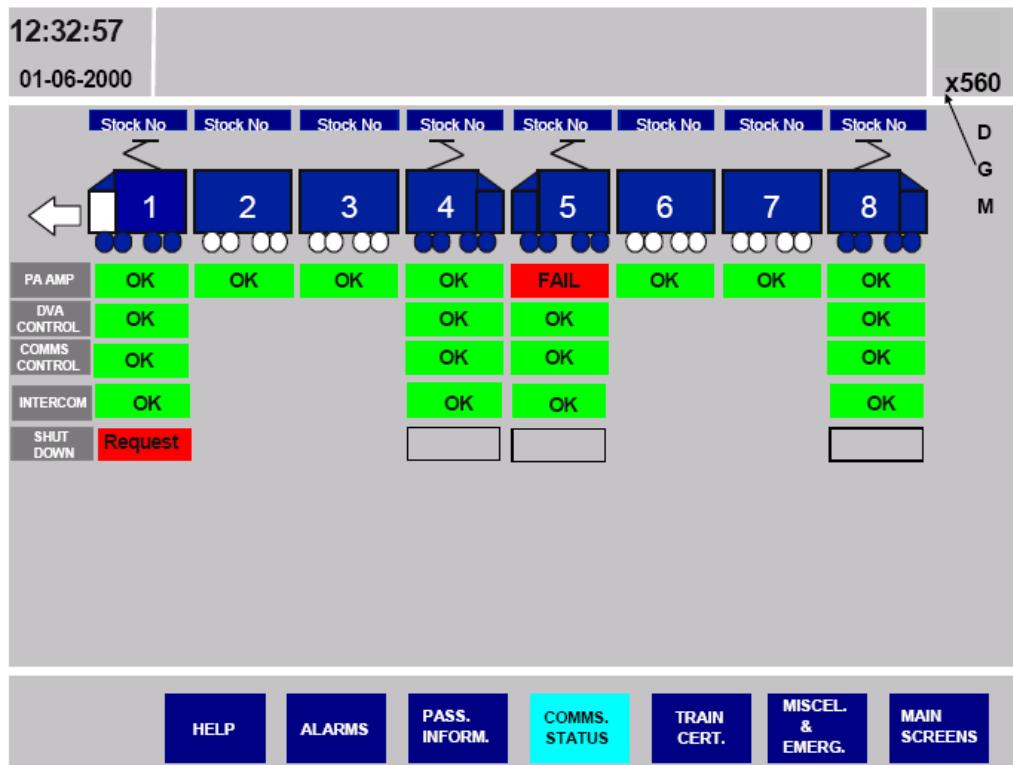
D  
G

BRAKES EQUIP'T STATUS

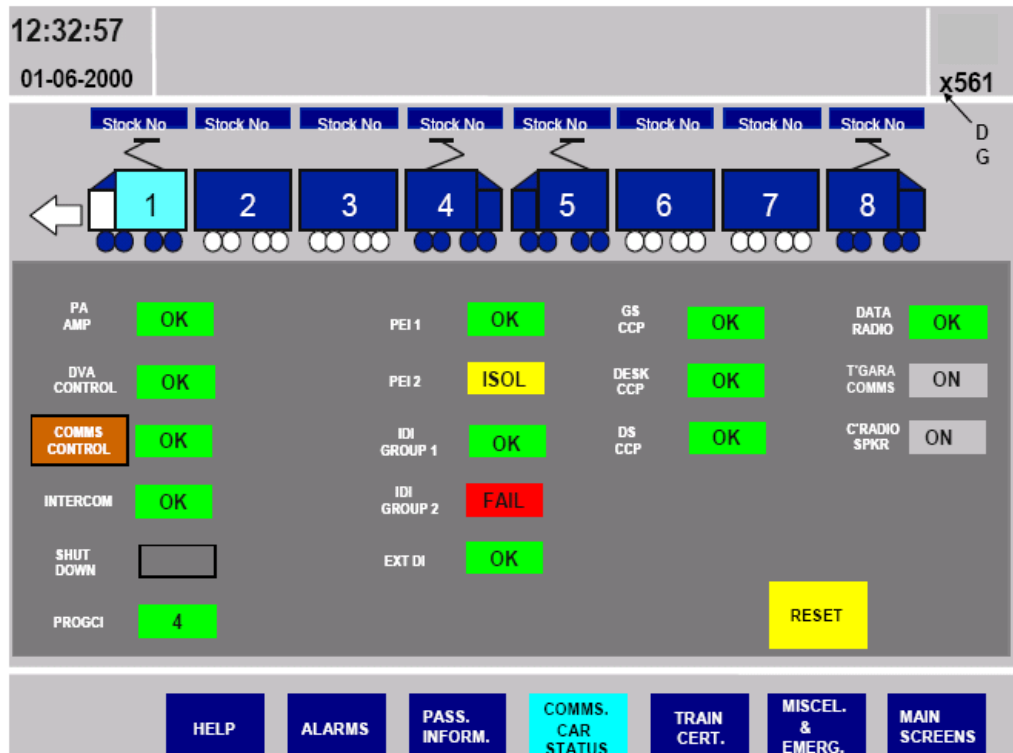
HELP ALARMS PASS. INFORM. BRAKES VALUES TRAIN CERT. MISCEL. & EMERG. MAIN SCREENS

30. Communications – Screen D560 (D-G-M)





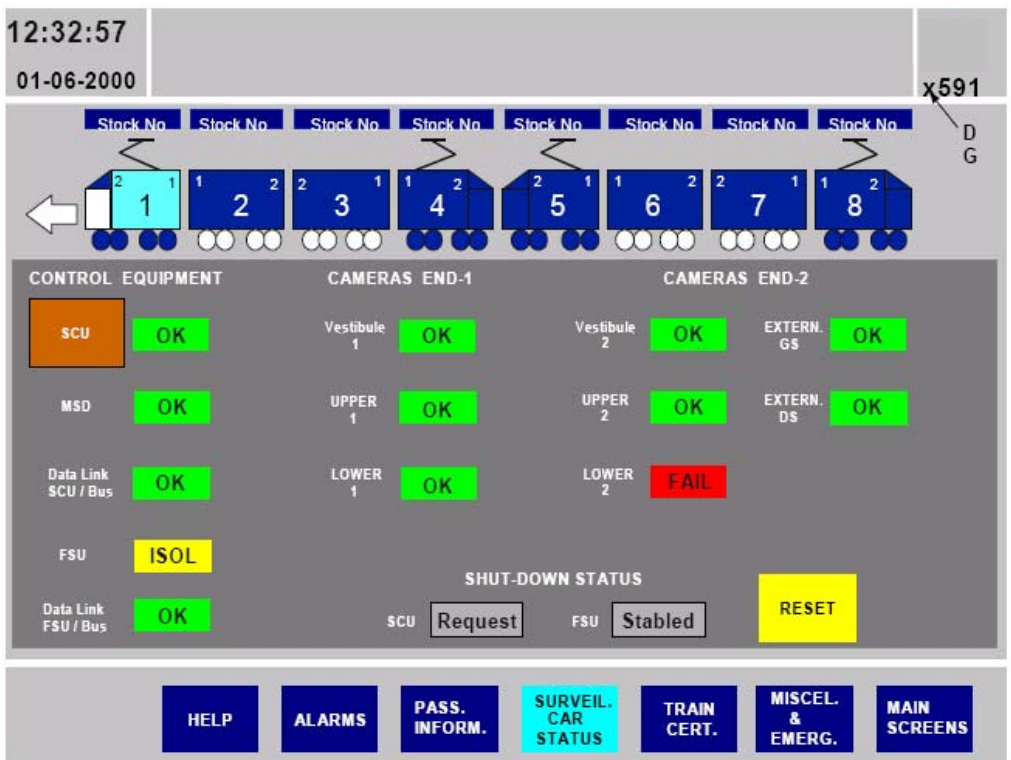
31. Communications Car Status – Screen D561a (D-G)



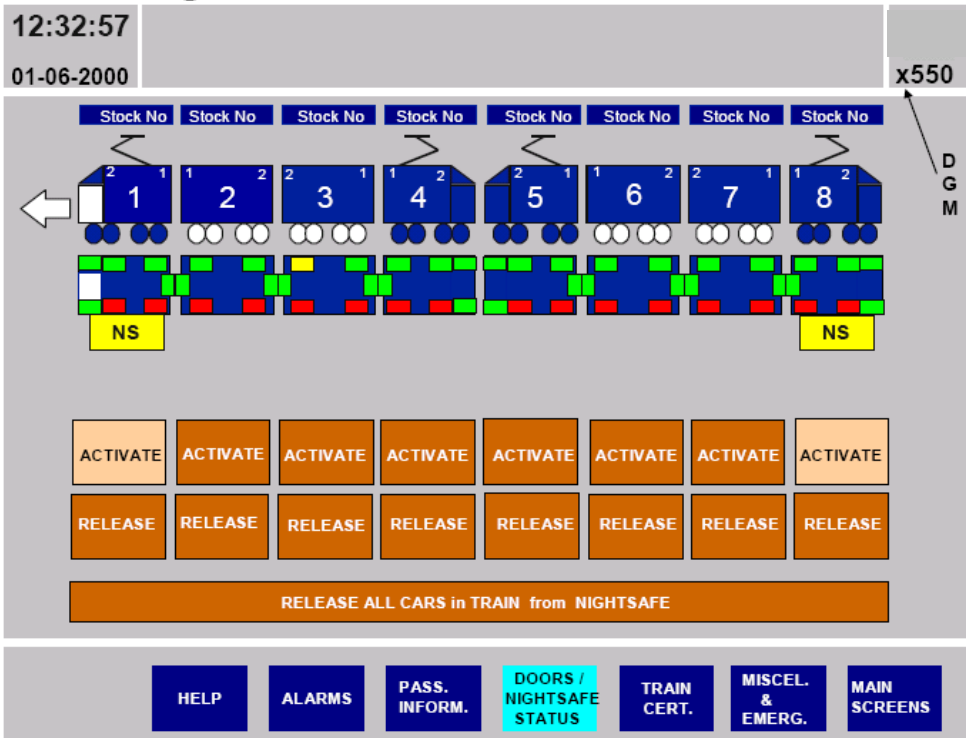
32. Surveillance – Screen D590 (D-G-M)



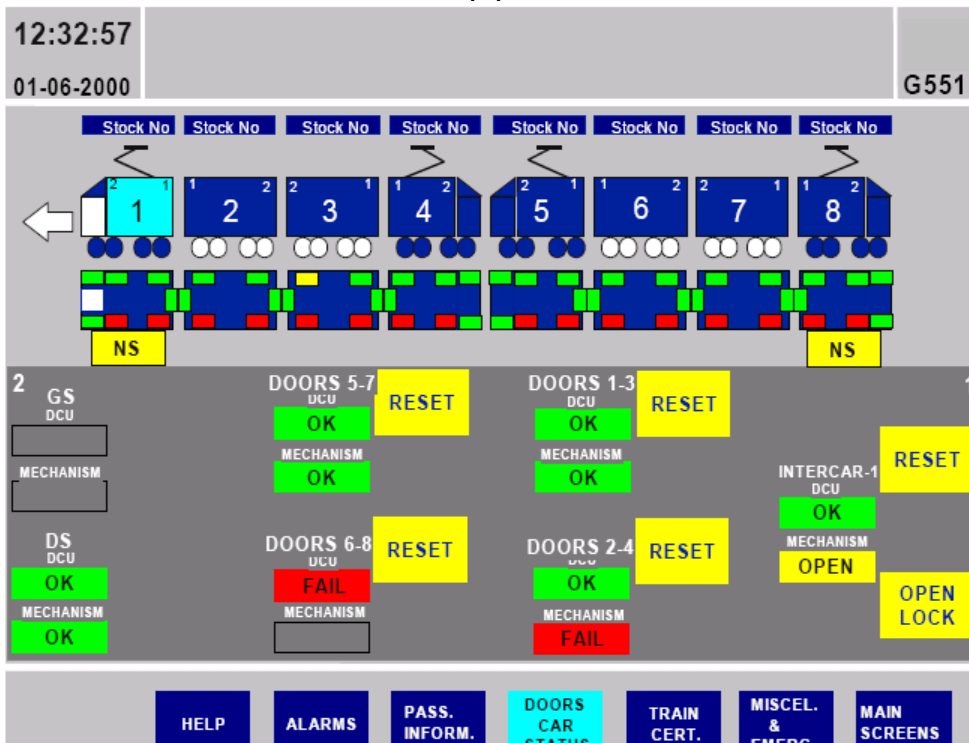
33. Surveillance Car Status – Screen D591a (D-G)



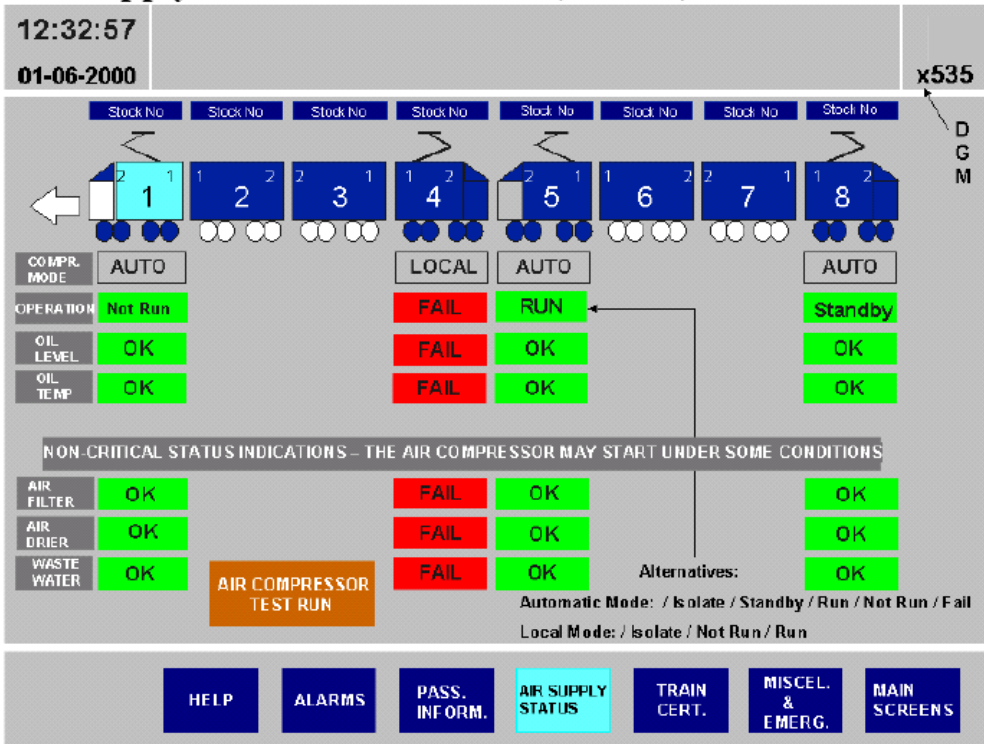
34. Doors / Nightsafe Status – Screen D550 (D-G-M)



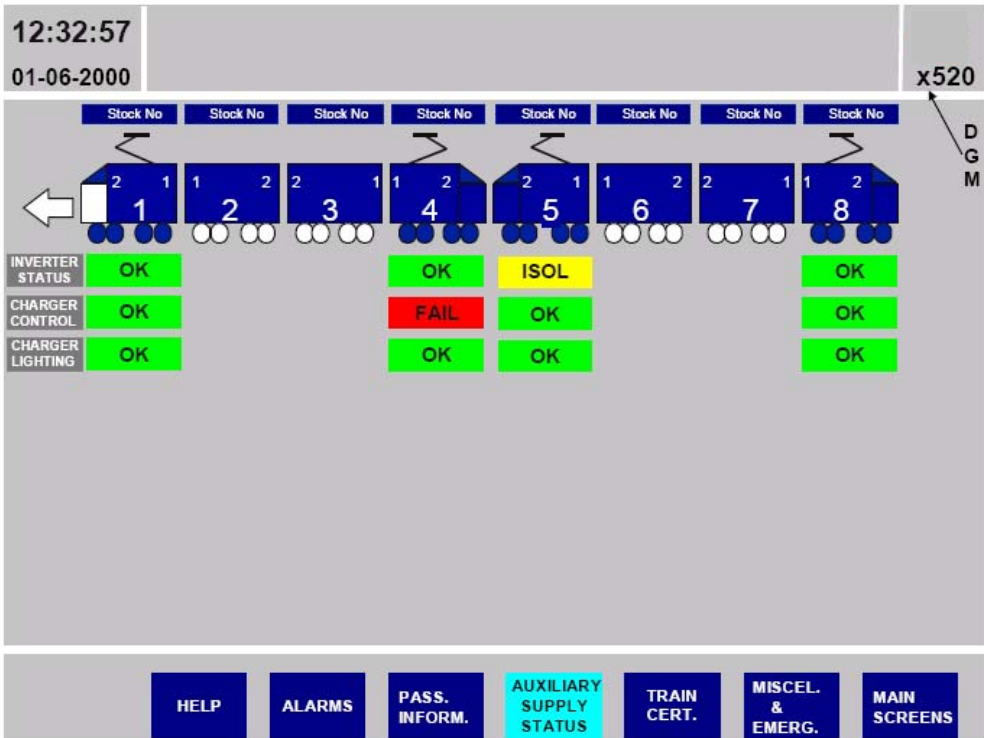
35. Door Car Status – Screen G551a (G)



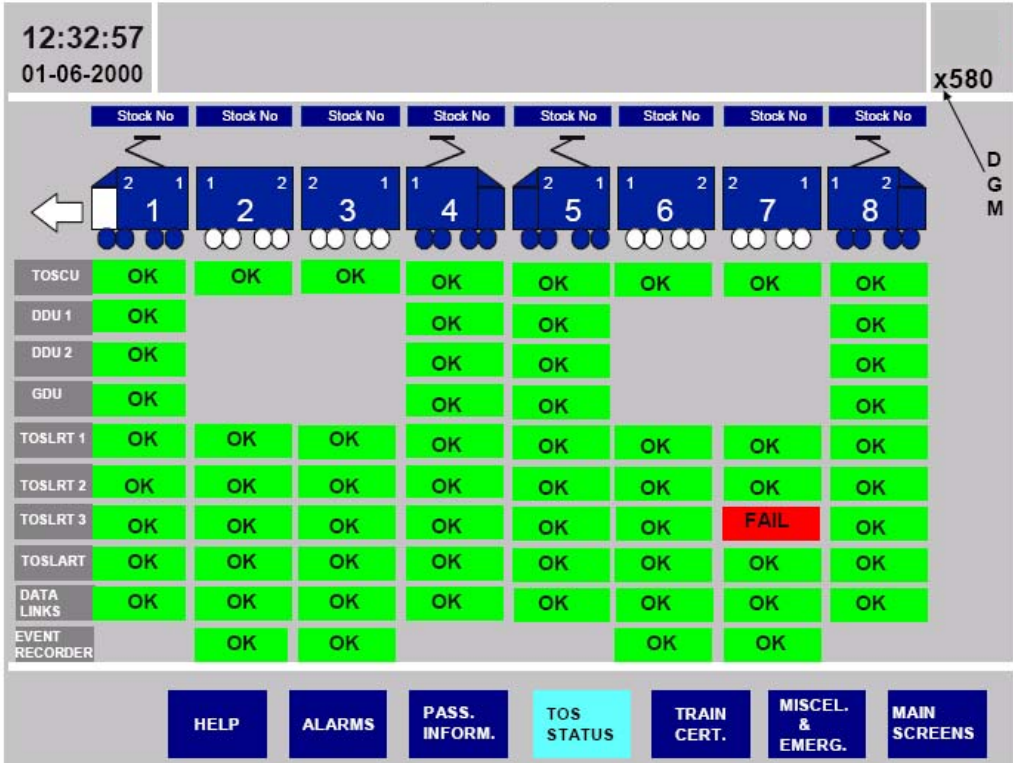
36. Air Supply Status – Screen D535 (D-G-M)



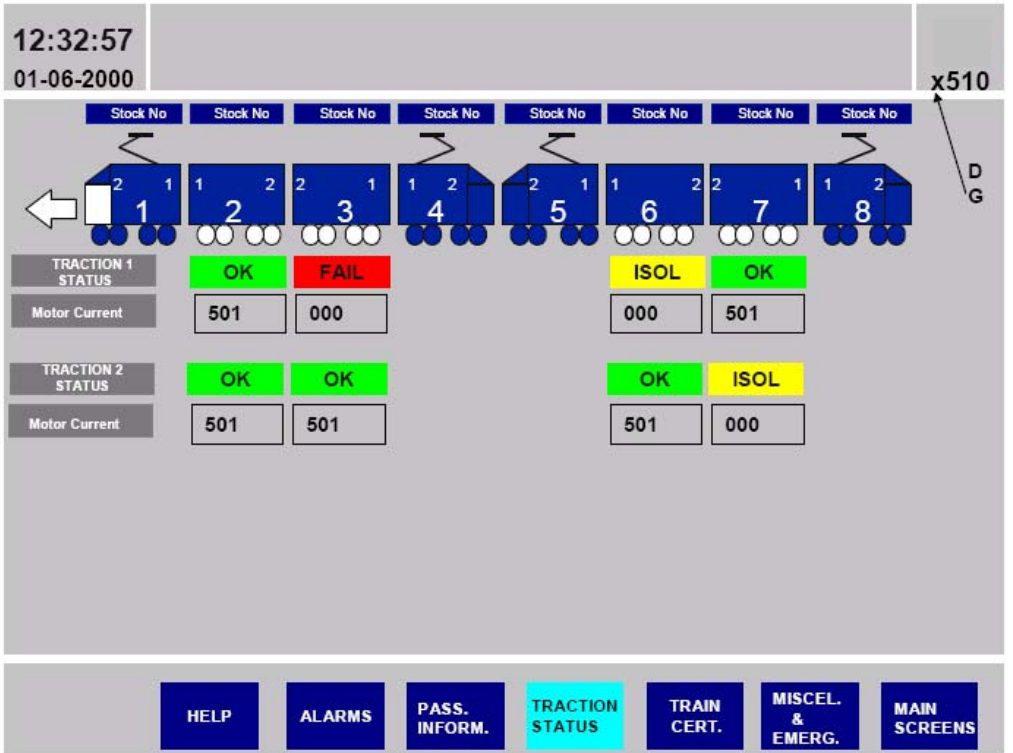
37. Auxiliary Supply Status – Screen D520 (D-G-M)



38. TOS Status – Screen D580 (D-G-M)



39. Traction Status – Screen D510 (D-G)



40. Traction Status Fault Reset – Screen D511

12:32:57  
01-06-2000 D511

TRACTION 1 STATUS	OK	FAIL
Motor Current	501	000
TRACTION 2 STATUS	OK	OK
Motor Current	501	501

TRACTION INVERTER No. 1		
INVERTER STATUS	ISOL	FILTER VOLTS
HSCB STATUS	OPEN	ACCEL.
DYNAMIC BRAKE	ENABLE	DECEL.
INVERTER DIRECTION	FWD	RHEO. BRAKE (kN)
DRIVING MODE	TRAC	REGEN. BRAKE (kN)
		1507
		0.53
		0.00
		10
		82

TRACTION INVERTER No. 2		
INVERTER STATUS	ISOL	FILTER VOLTS
HSCB STATUS	OPEN	ACCEL.
DYNAMIC BRAKE	ENABLE	DECEL.
INVERTER DIRECTION	REV	RHEO. BRAKE (kN)
DRIVING MODE	TRAC	REGEN. BRAKE (kN)
		1511
		0.55
		0.00
		15
		67

HELP ALARMS PASS. INFORM. **TRACTION STATUS** TRAIN CERT. MISCEL. & EMERG. MAIN SCREENS

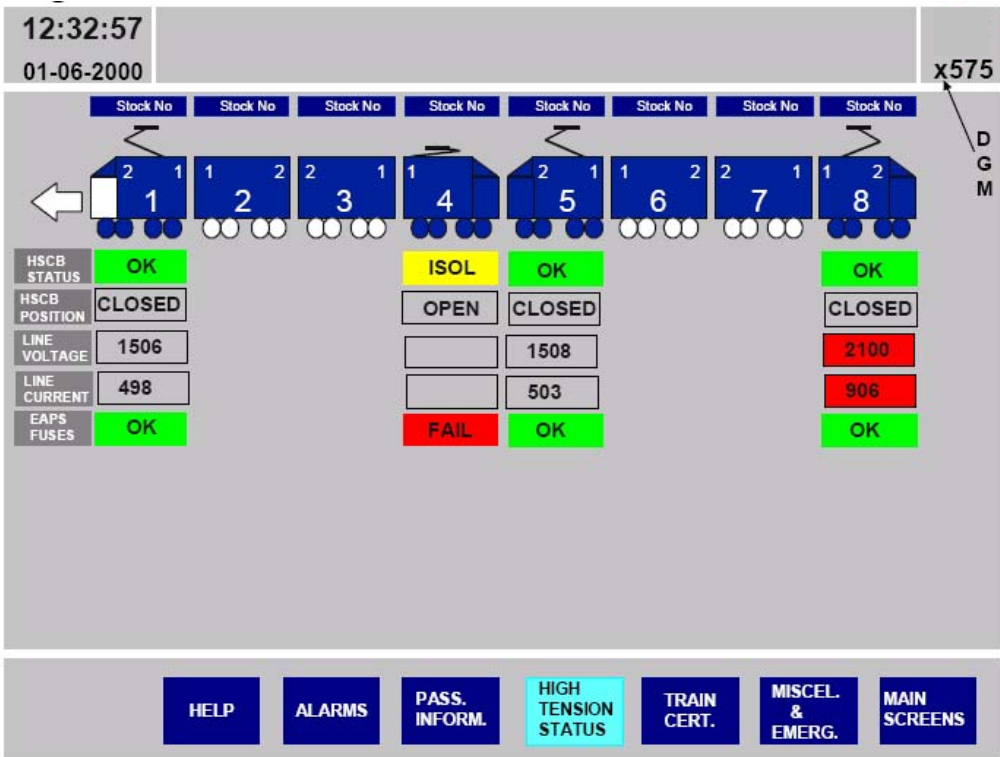
41. Low Tension Status – Screen D570 (D-G-M)

12:32:57  
01-06-2000 x570

	1	2	3	4	5	6	7	8
Doors	OK	OK	OK	OK	OK	OK	OK	Not OK
Cab/Desk	OK			OK	OK			Not OK
Locker 8 SW PNL	OK			OK	OK			Not OK
Locker 8	OK			OK	OK			OK
Locker 6	OK	OK	OK	OK	OK	OK	OK	Not OK
Locker 5		OK	OK			OK	OK	
Locker 4	OK	OK	OK	OK	OK	OK	OK	OK
Locker 3		OK	OK			OK	OK	

HELP ALARMS PASS. INFORM. **LOW TENSION STATUS** TRAIN CERT. MISCEL. & EMERG. MAIN SCREENS

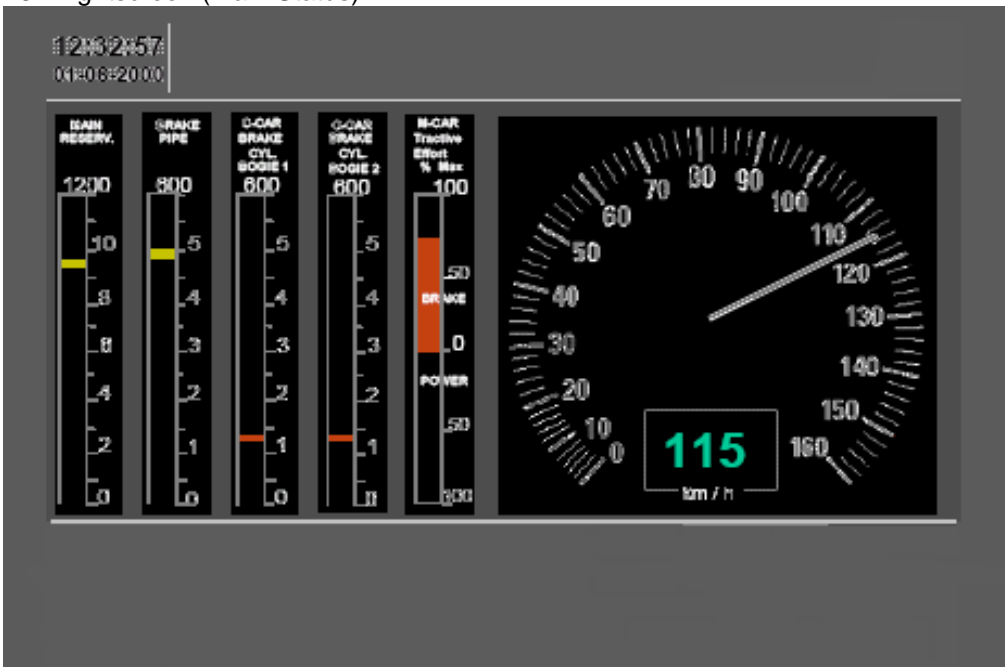
42. High Tension Status – Screen D575 (D-G-M)



**NOTE**

Regardless of information shown in the above screens all resets for the Doors, Air conditioning and Communications equipment shall be available to both crew members.

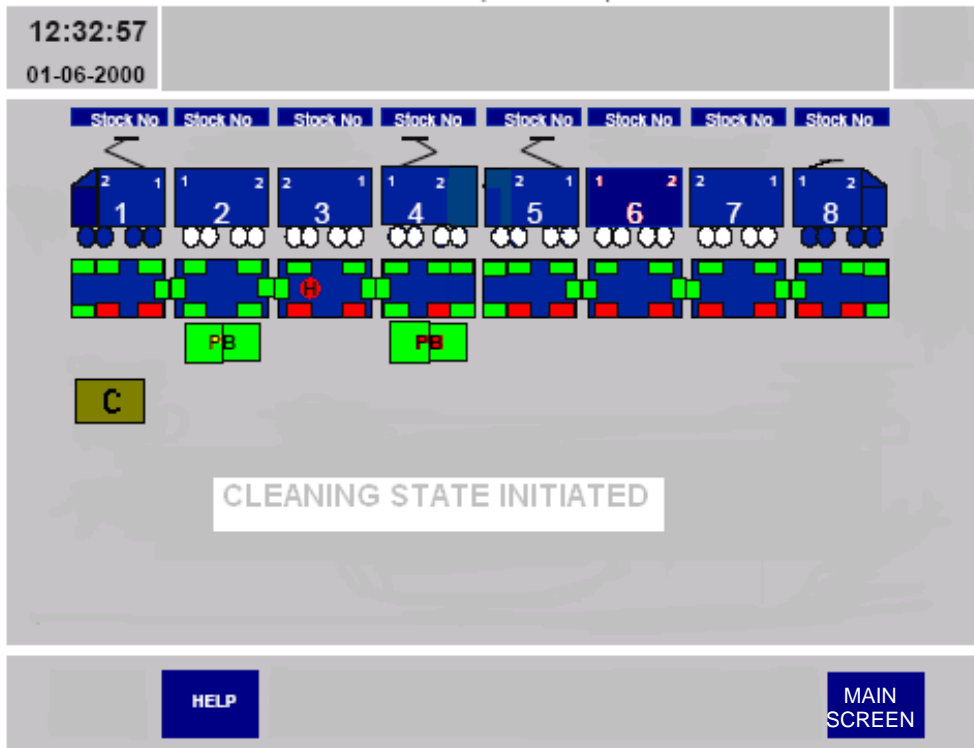
43. Nightscreen (Main Status)



**NOTE**

Touching the screen to revert back to Day Screen

#### 44. Cleaning State Screen



#### NOTE

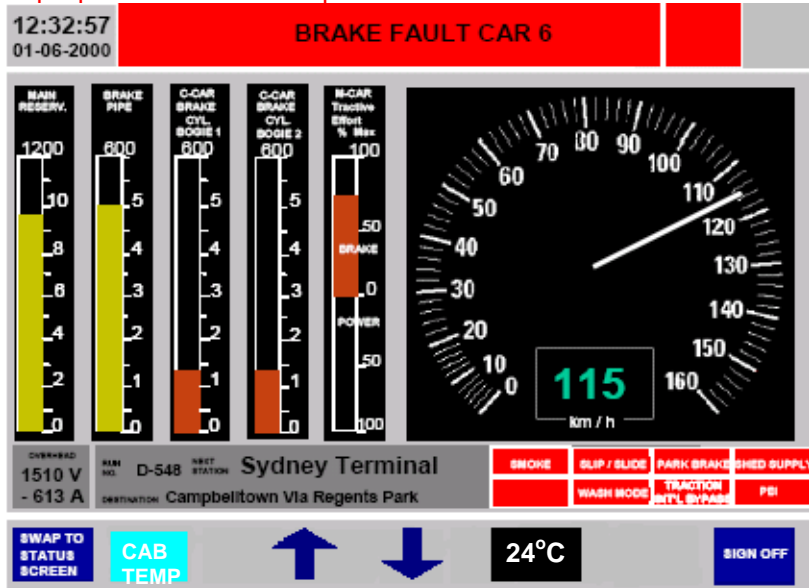
This indicative illustration is used to show the location of where the Cleaner's Key has been inserted in the train when Driver or Guard initiates Train Preparation. On acknowledgment from the Driver that a key is in the identified position the TOS shall disable the Cleaner's Key enabling the train to be prepared. The symbol used to indicate this state is only an example.

In order to return to the previous screen, this shall be possible via the Main Screen navigational button on the right. Initiated

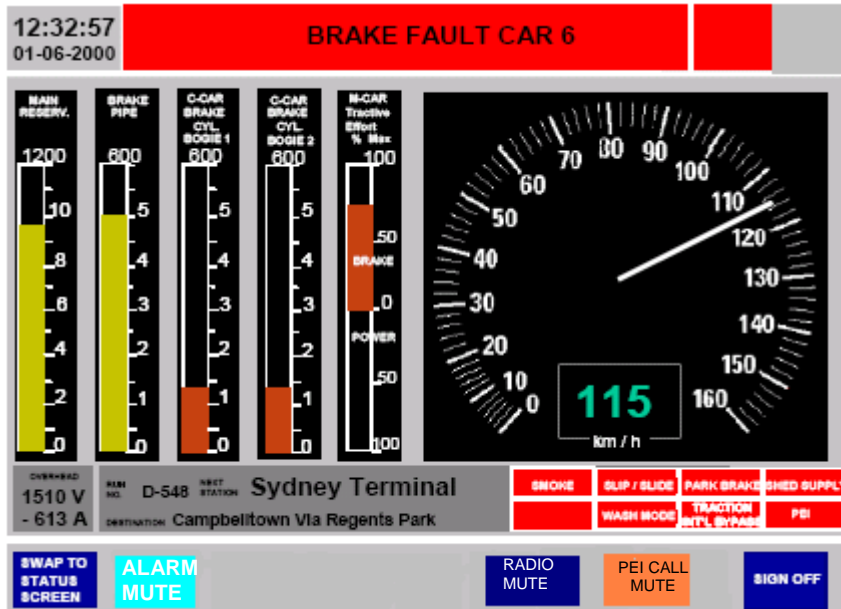
#### 45. Pop-Up Menus (from Main Status Screen)



Pop Up Menu for Cab Temperature



Pop Up menu for Alarm Mute



Pop Up Menu for Screen Brightness

12:32:57  
01-06-2000

**BRAKE FAULT CAR 6**

MAIN RESERV. 1200  
BRAKE PIPE 600  
C-CAR BRAKE CYL BOGIE 1 600  
C-CAR BRAKE CYL BOGIE 2 600  
H-CAR Tractive Effort % Max 100

1510 V  
- 613 A

REN. NO. D-548  
DESTINATION: Campbelltown Via Regents Park

Sydney Terminal

SMOKE  
SLIP / SLIDE  
PARK BRAKE  
WASH MODE  
TRACTION CTRL BYPASS  
PHED SUPPLY  
PEI

SWAP TO STATUS SCREEN  
SCREEN BRIGHT  
25%  
50%  
75%  
100%  
SIGN OFF

## APPENDIX N – EVENT RECORDER (ER)

### Change Log

Issue	Date	Author	Change
v8	CONTRACT		
v9	29/09/2008	CJEH	Addition of text changes from RFTA Group 1: 00084    00181 00177    00182
v10	18/11/2008	CJEH	Addition of text changes from RFTA Group 3: 00175    00179
v11	11/02/2009	ARJS	Addition of text changes from RFTA Group 5: 00176
v12	17/03/2009	ARJS	Addition of text changes from RFTA Group 7: 00178

v13	08/04/2009	ARJS	Addition of text changes from RFTA Group 9: 00183 00186 00277  Addition of text changes from RFTA Group 10: 00187
v14	30/06/2009	ARJS	Addition of text changes from RFTA Group 12: 00174  Addition of text changes from the following RFTA (No Group): 00230

	<b>1.0</b>	<b>Event Recorder (ER) Overview</b>	
	1.1		Accurately record selected operational data of the Set pertinent to investigation of abnormal events
	1.2		Allow data to be retrieved when required for analysis
	1.3		Provide support facilities to enable easy analysis of data
RFTA 00187	1.4	<u>Protocols Not Used</u>	<del>The Event Recorder shall be operated in line with StateRail's Train Crew Data Logger Protocol, dated 5/01/2004 and StateRail's Data Logger Information Management (Incidents) Procedures, Release 1.1, August 2003.</del>
	<b>2.0</b>	<b>ER Functionality</b>	
	2.1	On board Active State	ER shall be active whenever any auxiliary power supply battery power is available
	2.2	Modes of on board Active State	ER Active State shall have three modes: Record Data, Extract Data and Configure
	2.3	Modes of on board Inactive State	ER Inactive state shall have one mode: Extract Data
	2.4	Capabilities of Configure Mode	Shall have at least the following capabilities: Input Car Number, Time Set, Date Set, Parameter Adjustment
	2.5	Input Car Number	Input Car number capability shall enable the entry of the unique identifying Car number to be entered into the on board ER Subsystem
	2.6	Time Set	Time set capability shall enable the time of day, obtained from an accurate independent source to be entered into the on board ER
	2.7	Time Set Operation	Time set operation capability shall be conducted each time the on board ER changes from the Inactive to the Active state

	2.8	Date Set	Date set capability shall enable the date to be entered into the on board ER by authorised staff with Access 3 security
	2.9	Date Set Operation	Date set capability shall be conducted when the Set is in any state other than the Stabled state
	2.10	Parameter Adjustment	ER parameter adjustment capability shall enable adjustment of any adjustable parameters due to changed recording requirements
	<b>3.0</b>	<b>ER Capacity and Requirements</b>	
	3.1	Memory Capacity	The ER shall be able to contain at least seven days of data with a record of each input changing state every second before re-writing over older stored data on a first in, first out basis so that the most recent data recorded is maintained.
	3.2	Memory Type	Data shall be recorded in a non-volatile solid state memory.
RFTA 00182	3.3	Memory Function	The non-volatile memory shall retain data, including stored time and date data, maintain clock and calendar operation without external power for at least 4 months, whether it remains in a Set or is physically removed from the Event Recorder.
	3.4	Design Life	The ER shall have a design life of 30 years and no components shall require routine replacement at an interval of less than 10 years.
	3.5	ER Working	ER shall work whenever the Set is not in the Stabled state.
	3.6	ER Reliability Assessment	A reliability assessment shall be undertaken for the ER System. PPP Co shall submit this assessment to RailCorp prior to the CDR
	<b>4.0</b>	<b>System Architecture</b>	

4.1	Self Test Function	The ER shall be provided with a means of self testing when the System or Cab it is fitted to becomes active. If the self test determines that there is a Fault preventing operation of the ER then a Fault light will be displayed in the Driver's Cab.
4.2	Watchdog Function	The ER shall be fitted with an LED watchdog indicator on the front panel that pulses whilst the unit is operating correctly. This indication is intended to demonstrate that the core electronics are functioning (operating) correctly and not necessarily that all the inputs and outputs are operating correctly.
4.3	TOS Validation	The ER shall provide the TOS with a validation signal whilst its functional performance conforms to specification.
4.4	Self Diagnosis Report	The ER shall provide the TOS with a self-test Fault diagnosis report when functional performance does not conform to specification.
4.5	Automatic Fault Alert	The ER determines that there is a Fault preventing operation or there is an ER Failure during service then a Fault light will be displayed in the Driver's Cab.
4.6	Internal Time Clock Accuracy	Time-base accuracy shall be equal to or better than +/- 1 second of gain or loss per month.
4.7	Internal Time Stamp	The ER shall contain a clock stamp in the form: YYYY/MM/DD/HH:MM:SS:S/10
4.8	Data Download	The ER shall include a download facility to enable data and information from the ER to be downloaded. The ER shall also be able to offer the functionality to download information by remote and automatic means without operator intervention
4.9	Laptop Computer Data Extraction	Data shall normally be extracted in a non-proprietary data format from each ER on a Set with the use of a Wintel compatible laptop computer that can be plugged into a non-proprietary interface port on the ER
4.10	Memory Module Desktop Computer	The memory module shall be able to connect to a desktop computer to enable data extraction
4.11	Six Portable Laptop Computer	There shall be six portable Wintel compatible laptop computers, capable of extracting data from the ERs and associated special interface hardware and software supplied to accept and analyse ER data.

	4.12	ER Accessories	ER shall include all software and hardware accessories necessary for the extraction, analysis and display of the data on an IBM compatible personal computer with printer connection.
	4.13	Data Security	The ER shall have a built in password hierarchy to only permit data download and software upload by the appropriate authorised personnel.
	4.14	Extraction of Data	Extraction of data shall not clear the memory
	4.15	Data Single File	Data extracted shall automatically form a single file with an automatically generated unique file number that easily identifies the Car number and approximate date that data was extracted.
RFTA 00177	4.16	Source Data Protection	Original data files extracted shall be ' <del>read only</del> and not be able to be altered' encrypted or stored in a format <u>such that it can not be altered without detection</u> to enable use as evidence in court.
	4.17	Data Analysis and Display	Data analysis and display software package shall be a menu driven, Windows compatible software tool that allows easy analysis of retrievable data files
	4.18	Data Display	Analysis shall be done with data displayed in graphical form. Tabulated data shall also be possible
	4.19	Record Digital Signals	It shall be possible to record digital signals synchronously so that signals like the Driver-Guard operated bell codes and Driver operated horn code can be analysed. For example, a Guard may give a sequence of long and short bell operations in the space of 1 to 1.5 seconds that has a specific meaning. Dependent on the design of the ER offered, this ability may be restricted to a short term memory of most recently recorded data with long term memory just showing the particular device was operated within the sample interval. It is preferred that the long term memory could show this detail.
	4.20	Reconstruction of Event	It shall be possible to reconstruct events to an equivalent maximum, regular sampling interval that shall not exceed 1 second. A regular sampling interval of 0.5 second is preferred.
	4.21	Record Data Mode	The record data mode shall consist of recording data provided from the various inputs on the Set



RFTA 00176	4.22	<u>GPS Connectivity to Other Systems</u>	The Event Recorder shall have the capability to be connected to and provide selected data ( <u>including, but not limited to speed and distance travelled</u> ) to a <u>GPS unit in order future on-board system</u> to enable train speed to be <u>controlled monitored</u> as a function of its location.
	<b>5.0</b>	<b>Mechanical Requirements</b>	
	5.1	Operating Temperature	The ER shall have an operational ambient temperature range of -10 °C to +60°C, 0 to 95% relative humidity non-condensing.
RFTA 00174	5.2	<del>Thermal Protection Not Used</del>	<del>ER memory record unit shall have a thermal protection greater than or equal to 350 °C for ten minutes continuous.</del>
RFTA 00174	5.3	<del>Shock Protection Not Used</del>	<del>ER memory record unit shall have a shock protection greater than or equal to 50g in all directions.</del>
RFTA 00174	5.4	<del>Crush Protection Not Used</del>	<del>ER memory record unit shall have a crush protection greater than or equal to 20kN in all directions.</del>
RFTA 00174	5.5	Drop Protection	It shall be possible to drop a memory module from a height of 1 m onto a hard surface (e.g. concrete floor or solidly fixed steel plate) <del>several three (3) times (once on each axis) with no more than superficial mechanical damage (slight scratches and dents no deeper than 2mm) and no loss of data stored within the module.</del>  <u>It shall be possible to drop a memory module in its protective carrying case from a height of 1 m onto a hard surface (e.g. concrete floor or solidly fixed steel plate) three (3) times in each direction of each principal axis (total 9 times) with no mechanical damage to the module and no loss in mechanical and operational functionality of the module.</u>
RFTA 00174	5.6	Memory Module Protection	<del>The ER memory module shall be protected against fire and physical damage.</del> <u>The ER memory module shall comply with IEEE 1482.1:1999 for crashworthiness.</u>
	5.7	Vibration and Minimal Air	The ER equipment shall not fail due to Car body vibration and minimal air movement for cooling
	5.8	Physically Damaged Memory Module	If a memory module is physically damaged such that it is no longer possible to extract data via either a laptop or desktop computer, the PPP Co shall be able to offer the service of direct data extraction from undamaged integrated circuits of all information recorded during at least the last 10 minutes operation

RFTA 00183	5.9	Memory Transport	The ER's non-volatile memory shall be able to be transported by one person, either as a removable unit from the on board ER Subsystem <u>stored in a transportable enclosure</u> or otherwise as a part of the whole ER. Memory modules from an eight Car Set should fit within the space of dimensions 400 x 280 x <u>130</u> mm. <del>For one memory module the maximum weight shall not exceed 2.5 kg.</del>
	5.10	Location	The ER shall be located within the Set to minimise the risk of being damaged in the event of a collision or derailment. The ER shall not be located in the crumple zones of the cars.
	5.11	Lockable	Each ER shall be fitted with a locked lid that can only be opened by a master key. One master key shall be able to open all ERs. The keying System will match the existing System used by RailCorp for this purpose.
	5.12	ER Unit	The On board ER Subsystem shall form a self contained unit
	<b>6.0</b>	<b>Electrical Requirements</b>	
	6.1	Input Signal Protection	Each digital and analogue input shall have transient voltage and AC signal protection suitable for sustained connection to the electrical equipment found on the Set.

RFTA 00186	6.2	Power Supply	<p>The power supply shall be derived from the Set battery. The ER shall be capable of correct operation with a supply voltage minimum range of <math>\pm 15\%</math> of the nominal fully-charged Set battery voltage. The ER shall be capable of tolerating a power interruption of 200 mS without affecting the data recording functionality <u>unless the following signals are recorded on the other Event Recorder:</u></p> <ol style="list-style-type: none"> <li>1) <u>Car number.</u></li> <li>2) <u>Date of each event [day/month/year].</u></li> <li>3) <u>Time of each event [hour(0-24):minutes: seconds].</u></li> <li>4) <u>Speed [km/h] signal as displayed to Driver.</u></li> <li>5) <u>Distance travelled (both total and that since last start from standstill) [m].</u></li> <li>6) <u>Position of combined controller handle.</u></li> <li>7) <u>EP Brake Set wire status.</u></li> <li>8) <u>Brake Pipe pressure.</u></li> <li>9) <u>Operator Enable System circuit operation (including determination of whether Operator Enable Handle or Operator Enable Pedal involved).</u></li> <li>10) <u>Traction power control signal transmitted along the Set.</u></li> <li>11) <u>Horn operation.</u></li> <li>12) <u>Vigilance push button acknowledgment.</u></li> <li>13) <u>Vigilance foot pedal acknowledgment.</u></li> <li>14) <u>Vigilance penalty operation.</u></li> <li>15) <u>Bell signal operated with bell code timing.</u></li> <li>16) <u>Operation of either Headlight or Fog Lights.</u></li> <li>17) <u>Use of get home facility.</u></li> <li>18) <u>Emergency Button.</u></li> <li>19) <u>Fire Detection</u></li> </ol>
RFTA 00186	6.3	Battery Back-up	<p>The ER shall be provided with an internal battery or equivalent device with sufficient energy storage to allow the ER to continue to correctly record data for a period of 60 seconds after the <del>main power supply</del> <u>Main Power Supply</u> is interrupted.</p>

RFTA 00181	6.4	EMI/EMC Compliance	The ER shall comply <del>and be tested to an appropriate standard such a standard is</del> <u>with EN50155 and be tested in accordance with EN50121.</u>
	6.5	Transients	The ER shall be designed to function correctly in the Set environment found on the Set and the Sydney suburban network.
	6.6	Internal Wiring	All internal wiring shall be appropriately rated to meet the minimum electrical and mechanical requirements of this specification. Low Smoke Zero Halogen cables and wires are preferred.
RFTA 00084	6.7	External Wiring	All <del>internal</del> <u>external</u> wiring shall be appropriately rated to meet the minimum electrical and mechanical requirements of this specification. Low Smoke Zero Halogen cables and wires are preferred. If wiring has to run in <u>exposed</u> areas it shall be of a double insulated construction or be protected with a separate external conduit.
	<b>7.0</b>	<b>Operational Requirements</b>	
	7.1	Overview	Each Set shall have at least two ERs that record the same input information. Each ER will record continuously to a non-volatile memory all inputs that are connected.
	7.2	ER Subsystems	The ER shall have two subsystems being the on board ER subsystem and the Off board ER subsystem
	7.3	States of Off Board ER	The Off board ER subsystem shall have five states being: Upload Data, Configure Data, Analyse Data, Display Data and Print Data
	7.4	Operate Incorrectly	The ER System shall not cause a Set to operate incorrectly or fail as a result of either: any part of the ER System failing or any monitored System on the Set failing and inducing Failure of the ER in a manner that the ER in turn induces other Set systems to fail.
	7.5	Access time	The time on the Set to either gain access to the data extraction port and plug into the laptop computer or, to unplug the data port and secure access, shall not exceed a median value of 45 seconds form boarding the Car in which the ER access port is mounted

7.6	Download Time	<p>The time to download the complete data memory of the ER, once the data port is connected, shall be less than 5 minutes. This time includes the initiating key strokes on the laptop computer after the data port connection is made until the time all data is confirmed to have been successfully retrieved.</p> <p>The time to download the complete data memory of the ER via wireless means shall be less than 60 minutes and shall be capable of being scheduled and completed, without operator intervention, to a remote location.</p>
7.7	Self Checking	Level 1 maintenance shall be limited to self checking and Driver monitoring of automatic Fault indication
7.8	Onboard Data Extraction	The ER shall permit data to be extracted to a Portable Data Extraction Device while the ER is on board the Set.
7.9	Off-board Data Extraction	The ER shall permit data to be extracted to a desk top IBM compatible personal computer, after the ER has been removed from the Set.
7.10	PC Support	The ER data extraction shall be performed using software that can be executed on IBM - compatible personal computers, using Microsoft Windows 3.1 or higher.
7.11	Data Access	The ER shall enable the recorded data to be extracted by authorised personnel only
7.12	Set Car number	The ER shall record the number of the Car in which it is located.
7.13	Time and Date Confirmation	The Crew shall be able to confirm that the ER clock has been set correctly by comparing the time and date with that displayed by the TOS.
<b>8.0</b>	<b>Test Equipment and Installation</b>	

8.1	ER Maintenance Requirement	<p>Level 2 maintenance requirements. Level 2 maintenance requirements shall be as listed:</p> <p>a). The reliability of the event recording and analysis System shall not require an interval of less than 90 days, preferably 180 or 360 days, to perform functional checks to locate otherwise hidden failures. (See also Clause 2.8.2 Maintenance Centre Support.) These tasks may include a memory battery check (if used for non-volatile memory), routine data extraction to confirm operation of data retrieval and analysis System, or other test routine that can be confirmed by test lamps or laptop computer. These tasks shall normally require less than 4 minutes on-train activity per ER. This time may extend to a maximum of 10 minutes where an Event Recorder module, circuit card, or battery requires replacement.</p>
		<p>b). Replacement of any batteries used internally in the ER shall not require replacement for a minimum of 4 years in service.</p>
		<p>c). Physical replacement of a memory module shall take less than 5 minutes.</p>
<b>9.0</b>	<b>ER Input Signals</b>	
9.1	Information to be recorded	<ol style="list-style-type: none"> <li>1) Car number.</li> <li>2) Date of each event [day/month/year].</li> <li>3) Time of each event [hour(0-24):minutes: seconds].</li> <li>4) Speed [km/h] signal as displayed to Driver.</li> <li>5) Operation of the Crew Door emergency close command.</li> <li>6) Use of Cab access door control</li> <li>7) Distance travelled (both total and that since last start from standstill) [m].</li> <li>8) Train location (via transponders)</li> </ol>

			<ul style="list-style-type: none"><li>9) Acceleration / Deceleration [m/s<sup>2</sup>]. This can be a derived value.</li><li>10) Position of combined controller handle.</li><li>11) Energy import (drawn by Set from OHW)</li><li>12) Energy export (regenerated to OHW)</li><li>13) Energy used by rheostatic brake and auxiliaries</li><li>14) EP Brake Set wire status.</li><li>15) Regenerative brakes ON or OFF</li><li>16) Brake Pipe pressure.</li><li>17) Brake cylinder pressures for all bogies (measured at the bogie side of the bogie isolation cock.</li><li>18) Operator Enable System circuit operation (including determination of whether Operator Enable Handle or Operator Enable Pedal involved).</li><li>19) Traction power control signal transmitted along the Set.</li><li>20) Line current (total)</li><li>21) Line voltage.</li><li>22) Train load (Passengers)</li><li>23) Horn operation.</li></ul>
--	--	--	---

			<ul style="list-style-type: none"><li>24) Park Brake ON / OFF command signals.</li><li>25) Park Brake feedback status.</li><li>26) Wheel slip/slide indication.</li><li>27) Vigilance push button acknowledgment.</li><li>28) Vigilance foot pedal acknowledgment.</li><li>29) Vigilance penalty operation.</li><li>30) Door command operation for close, open, release.</li><li>31) Door Open indication monitoring.</li><li>32) Bell signal operated with bell code timing, and</li><li>33) Compressor synchronisation</li><li>34) Motor cut-out switch operation</li><li>35) ER memory boards ID</li><li>36) Brake blending signals.</li><li>37) Traction motor currents for each motor bogie.</li><li>38) Not used.</li><li>39) Operation of either Headlight or Fog Lights.</li></ul>
--	--	--	--



<p><u>RFTA 00179</u></p> <p><u>RFTA 00277</u></p>			<p>40) Wheel diameter correction.</p> <p>41) Identification of data memory module or card on which data was recorded and extracted, i.e.. a unique identification code of each hardware memory unit that is "attached" to blocks of recorded data.</p> <p>42) Use of get home facility</p> <p>43) Emergency Door Release (EDR)</p> <p>44) Passenger Emergency Intercom (PEI)</p> <p>45) <u>Fire Detection System (Level 1 and Level 2 Detection)</u></p> <p>46) <u>Safety System Suppression (Emergency Button)</u></p> <p>47) <u>Identification of Active Driver's Cab</u></p> <p>48) <u>Identification of Active Guard's Cab</u></p> <p>49) <u>Driver's sign-on code</u></p> <p>50) <u>Guard's sign-on code</u></p> <p>51) <u>Traction Interlock Bypass Activation</u></p> <p>52) <u>Reverser Handle Position</u></p> <p>53) <u>Vigilance Acknowledgement general (including task linked)</u></p> <p>54) <u>Door open status for each Passenger bodyside door</u></p>
---	--	--	---

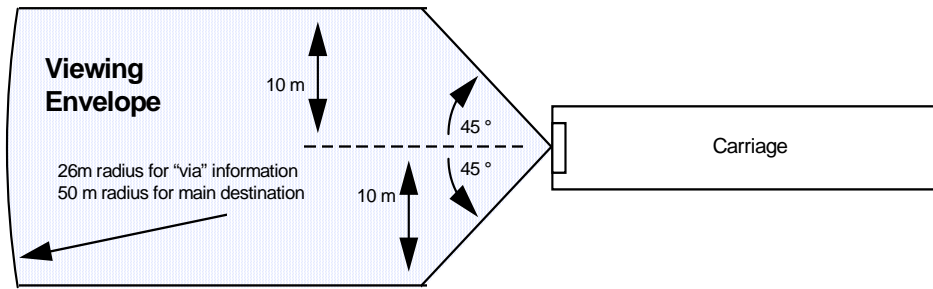
			<p>55) <u>Use of the Guard's Emergency Cock</u></p> <p>56) <u>Main Reservoir Pressure</u></p> <p>57) <u>PA activation</u></p>
RFTA 00230	9.3	ER Additional Capacity	<p>ER shall have additional capacity to record at least 10 additional analogue and 10 additional digital channels. <u>The following spare inputs shall be used for:</u></p> <p><u>Digital spare input #1 – Yard Horn operation – refer RFTA00230.</u></p>
	9.4	Record Speed Indicated to Driver	Speed recorded by the ER shall be the actual speed indicated to the Driver, such that no discrepancy between indicated and recorded speed is possible
	9.5	Speedo Calibration Confirmation	The speedo shall provide a definite indication to the Driver to confirm that the speed indicated matches the full scale speed calibration signal recorded on the ER
	9.6	Recorded Speed	Recorded speed shall be accurate to within +/- 0.5 km/h exclusive of wheel diameter correction and wheel slip/slide inaccuracies. A test Method shall be provided which readily confirms the correlation in speed shown on the speedometer at various values throughout the operating range against the speed recorded on the ER
	9.7	Recorded distance	The Set cumulative kilometre figure shall be held on the Set in a manner that ensures the total Set kilometres is not lost when equipment on the Set is changed out.
RFTA 00175	9.8	Manually Entered Wheel Diameter	<p><del>Manually entered wheel diameters shall be to a resolution equal to or better than correction shall be accurate to within +/- 2.5 mm. There shall be no difference between the wheel diameter manually entered and the wheel diameter recorded in the Event Recorder.</del></p> <p><u>Manually entered wheel diameters shall be to a resolution equal to or better than correction shall be accurate to within +/- 2.5 mm. There shall be no difference between the wheel diameter manually entered and the wheel diameter recorded in the Event Recorder.</u></p>
	9.9	Recorded Air pressures	Recorded air pressures shall be accurate, inclusive of digital quantisation, to within $\pm 5$ kPa for the brake cylinder pressures and to within $\pm 10$ kPa for the Brake Pipe pressure.

9.10	Recorded Analogue Signal Voltages	Recorded air pressures shall be accurate inclusive of digital quantisation to within +/- 1.6%.
9.11	Intercom	The ER shall monitor Passenger Emergency Intercom transmission and record and allow authorised extraction of: initiation time, duration and location of each call.
<b>10.0</b>	<b>ER Software Requirements</b>	
		PPP Co. shall provide any software required to facilitate the data exchange between the ER and a laptop computer. There shall be no licensing restriction to the use of this software.
10.1		Provide a graphical user interface including menus, windows, icons and on-screen buttons.
10.2		Provide interactive on-screen help.
RFTA 00178	10.3	Provide, <u>for a competent and trained user</u> , user-friendly data search functions for each recorded data channel.
	10.4	Have the ability to graphically display on-screen any number from one (1) to a minimum of 20 concurrent channels, of which at least 6 of these can display analogue data if required.
	10.5	Have the ability to change the individual colours used to draw each displayed analogue channel.
	10.6	Have the capacity to display multiple simultaneous plots of any selection of up to 20 channels of data on the same set of axes, permitting the comparison of data from different channels.
	10.7	Provide an optional grid overlay on displayed analogue data.
	10.8	Provide the option to change at any time the data channels to be displayed as well as the order in which they are presented.

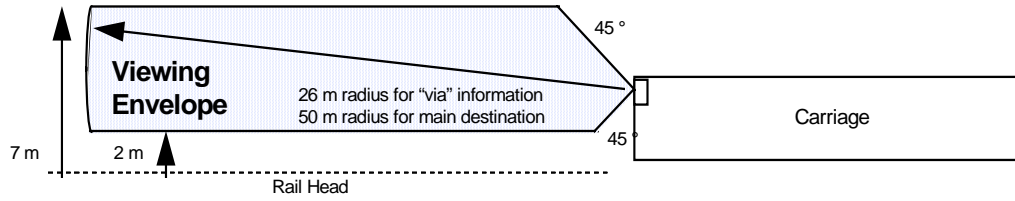
10.9	Provide the choice of either absolute or relative values of distance or time displayed for the horizontal x-axis when data is displayed graphically. Relative values shall be measured from a user selected reference point that can be easily changed.
10.10	Provide cursor interrogation of all data displayed with the cursor moving horizontally along the x-axis as directed by the computer keyboard and/or mouse operated pointer.
10.11	Provide quick left and right scroll functions when graphically displaying data to enable the displayed window of data to be easily moved back and forth through the recorded data. Similarly a similar scroll function shall allow quick movement up and down through the data when it is displayed in tabular form.
10.12	Provide screen movement about the cursor display, i.e. move left, move right or centre about the cursor.
10.13	Provide an indicator bar to show graphically the chronological location in the file of the currently displayed data.
10.14	Provide magnification zoom in and zoom out functions of graphical displays of data.
10.15	Provide in the graphical display mode the choice for each analogue channel of setting the maximum value that can be displayed, i.e. a size scaling function for each graphical plot.
10.16	Provide "strip chart" type graphical output of part or all of the data, of some or all of the channels, at various resolutions with options to print to a dot matrix, laser or colour printer. This shall provide a hardcopy of what is displayed on the computer screen for use in written reports of events.
10.17	Provide on-screen-tabular listing of data, with print option to either a dot matrix or laser printer.
10.18	Enable random access throughout a recorded data file for all data display options (i.e.. a "Go To" type function).
10.19	Provide distance calculation between two points denoted by cursor input and present this data in a format, giving start and end times and velocities, with a print option.
10.20	Allow marker flags with short texts to be positioned at user selected distances or times on displayed data.

10.21	Provide a search function with ability to search on multiple parameters that the user can determine. It shall also be possible to immediately cancel the search at any time after it has started.
10.22	Provide a statistics function giving the number of operations for each digital signal and the maximum amplitude for each analogue signal as well as the distance travelled within the optioned time period. This function shall have a print option.
10.23	Provide a wheel diameter record that is used to display speed, distance and acceleration data corrected for (average) wheel diameter. It shall not alter the original ER file;
10.24	It shall be possible to display speed, distance and acceleration that have been corrected for (average) wheel diameter with such displays indicating corrected values. (Note: Use of an "average" diameter applies for where recorded speed data is averaged from two or more wheelsets).
10.25	Provide the ability to simultaneously show selected data (i.e. selected time window and data channels) as per foregoing clauses from 2 to a maximum of six ERs (assuming one ER per motor-trailer pair). This shall allow analysis of events on a 8-Car Set of any number of ERs from two through to six. As there may be slight time clock differences amongst these recorders there shall be a facility to easily offset data displayed for each ER in 0.5 second steps or smaller (or at least half of whatever the minimum data reconstruction interval is). To minimise memory requirements of the analysis computer, only the selected time and date interval plus selected data channels (see point 3 and 4 above) from each of the recorders need to be loaded into the computer for analysis.
10.26	On-screen display and printout to show signal description, range and zero reference for each signal displayed.

## APPENDIX O - DESTINATION INDICATOR VIEWING ENVELOPE

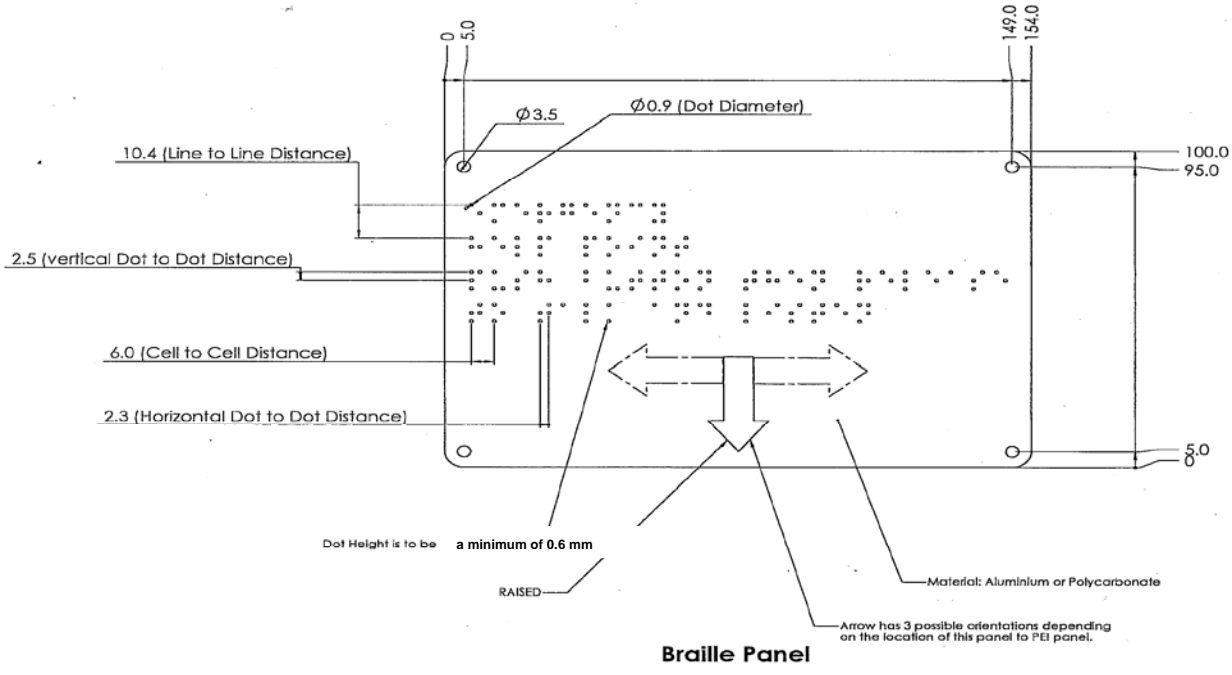
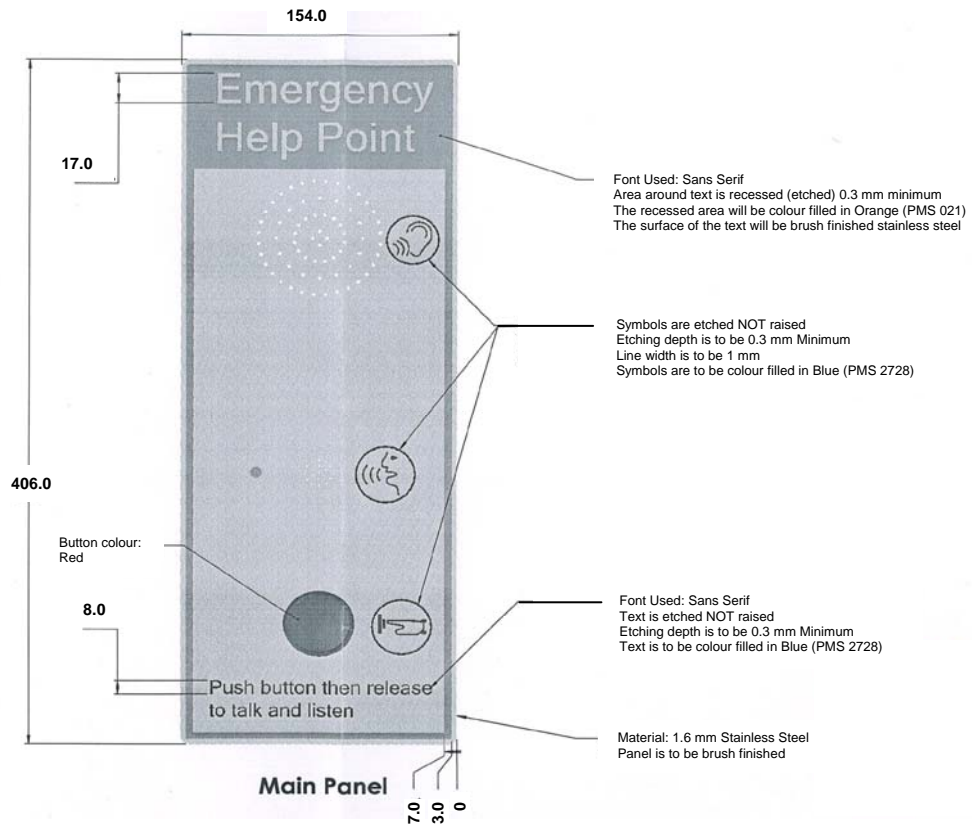


**Figure 1 – Plan View**



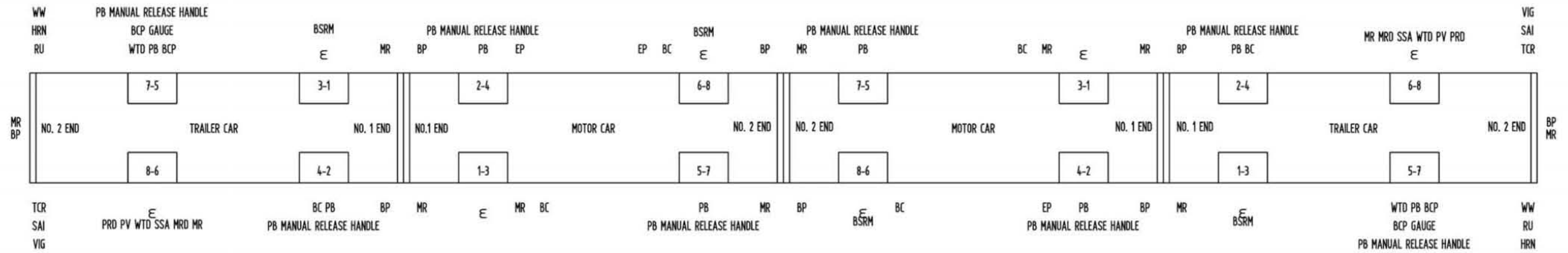
**Figure 2 – Elevation View**

# APPENDIX P – PEI SIGNAGE



## APPENDIX Q – ISOLATING COCK POSITIONS

### EXTERNAL ISOLATING COCK POSITIONS



BCP	BRAKE CYLINDER PRESSURE
BCP GAUGE	BRAKE CYLINDER PRESSURE AIR GAUGE
EP	EP BRAKE SUPPLY
BP	BRAKE PIPE
BP GAUGE	BRAKE PIPE AIR PRESSURE GAUGE
EM	EMERGENCY

HRN	HORN ISOLATION
ε	LOAD COMPENSATION/AIR SUSPENSION
MR	MAIN RESERVOIR
MRD	MAIN RESERVOIR DRAIN
PB	PARK BRAKE
PB GAUGE	PARK BRAKE PRESSURE GAUGE
PBC	PARK BRAKE CONTROL

PRD	PANTOGRAPH RESERVOIR DRAIN
VIG	VIGILANCE PENALTY
PI	PANTOGRAPH LOCAL SUPPLY AIR ISOLATION
P GAUGE	PANTOGRAPH PRESSURE GAUGE
PV	PANTOGRAPH VALVE
SAI	SAFETY APPARATUS

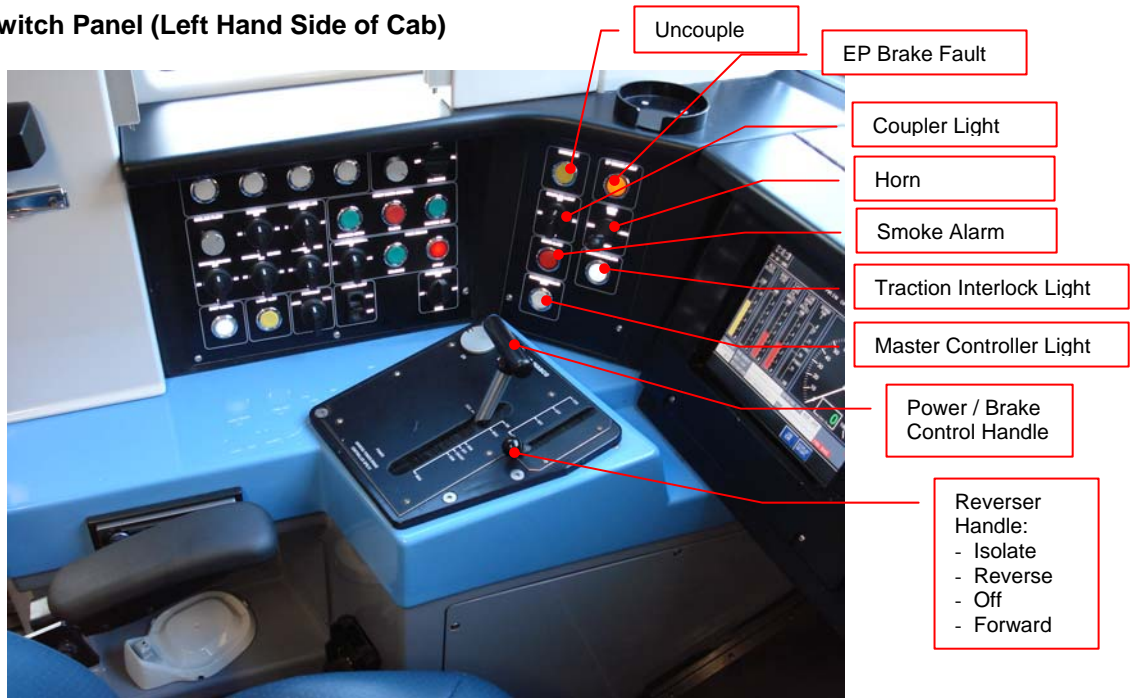
SSA	SHORE SUPPLY AIR
TCR	TRIP COCK RAISE
RU	REMOTE UNCOUPLE
WTD	WASTE TANK DRAIN
WV	WINDSCREEN WASHER WATER
BSRM	BRAKE SUPPLY RESERVOIR MAIN
ABV	AUXILIARY BRAKE (ISOLATION) VALVE



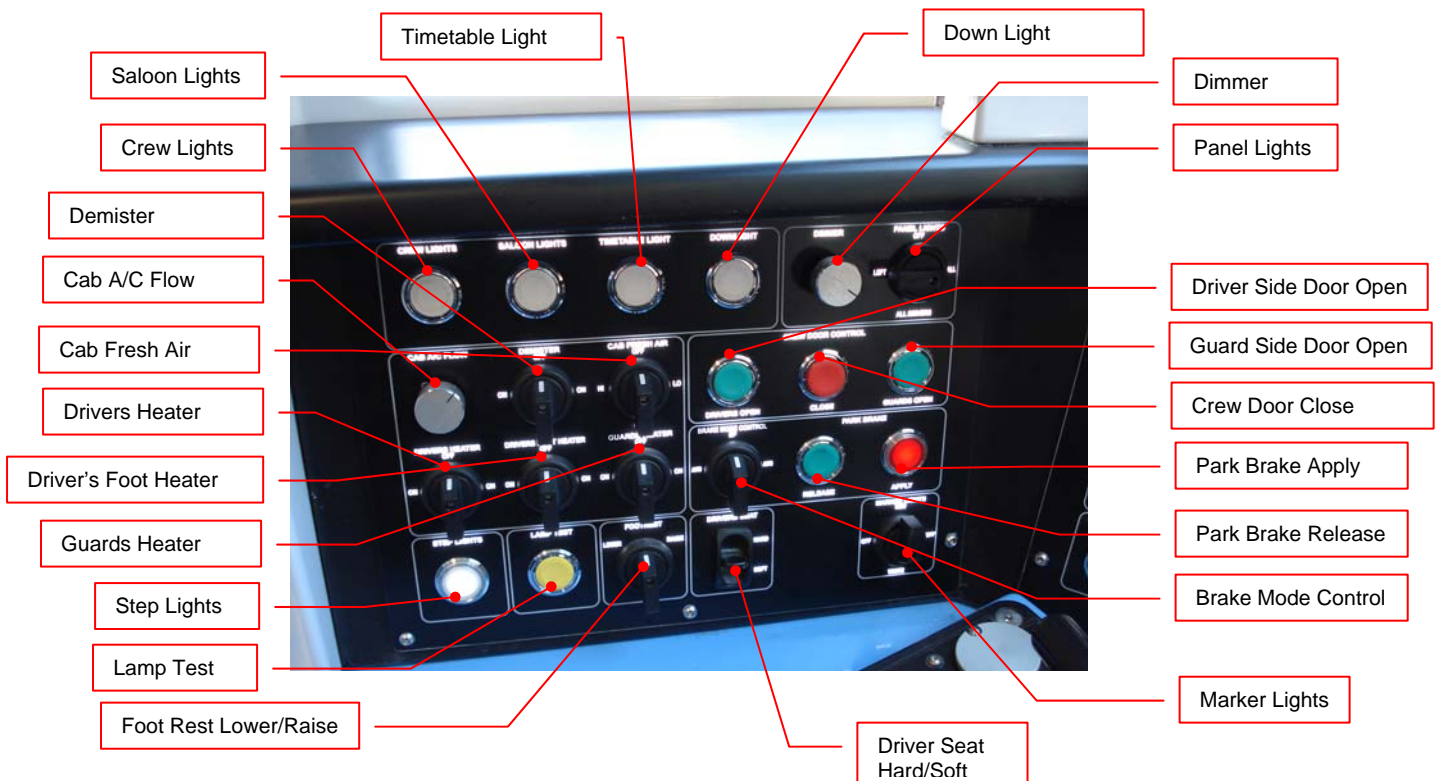
## APPENDIX R – CREW SWITCH PANELS

**Note:** The images shown are indicative of the cab arrangement sought by RailCorp. PPP Co shall aim to maximise consistency of layout with the images shown subject to compliance with the contract requirements and consultation with user groups during the mock-up and other design development stages.

### Driver's Switch Panel (Left Hand Side of Cab)



### Detail of Driver's Switch Panel



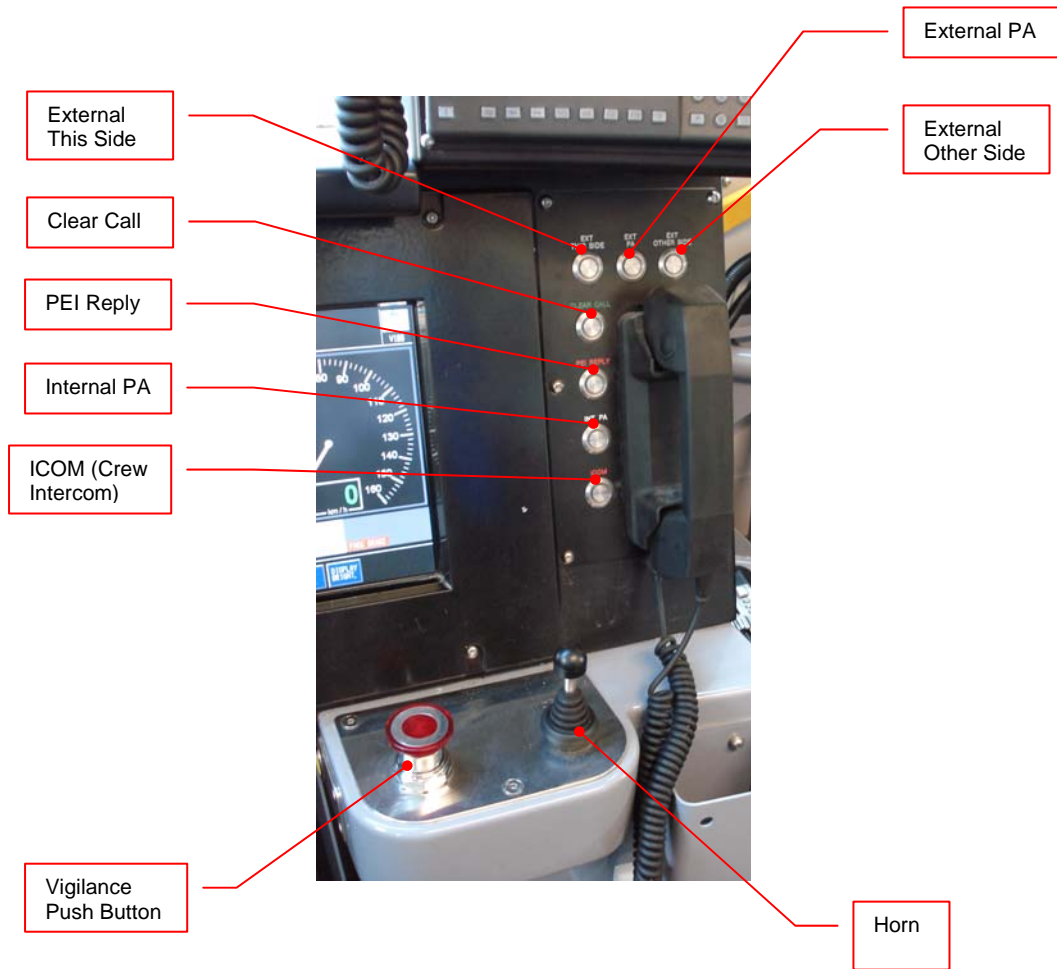
## Driver's Main Console (DDU Screens and Centre Switch Panel)



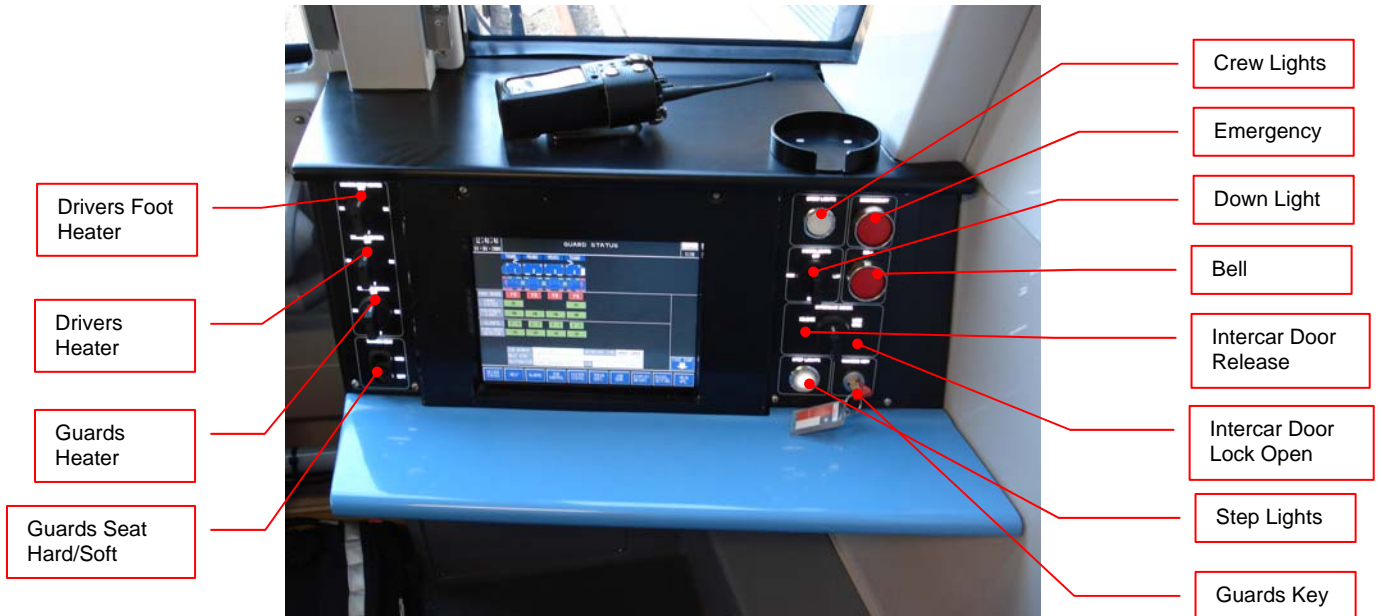
## Detail of Centre Switch Panel



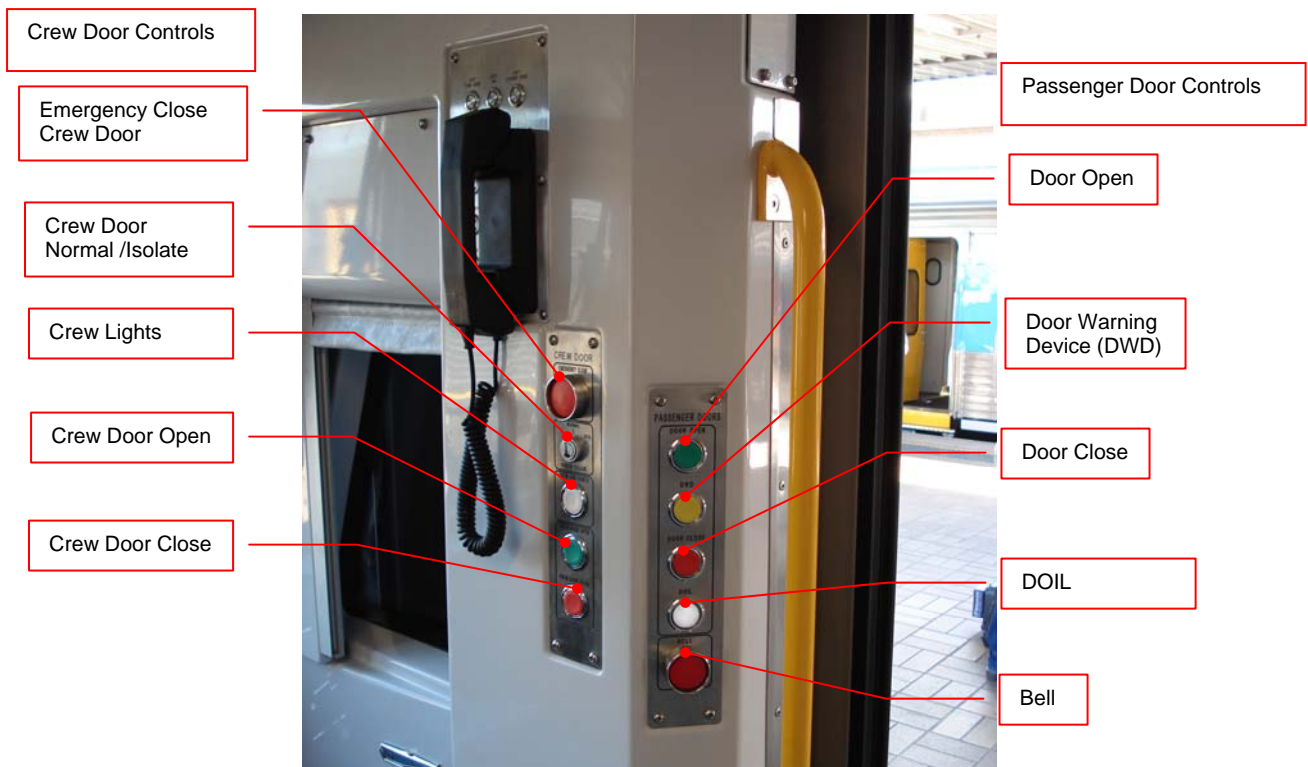
## Crew PA Intercom Handset, Horn and Vigilance Controls



### Guard's Switch Panel (Right Hand Side of Cab)



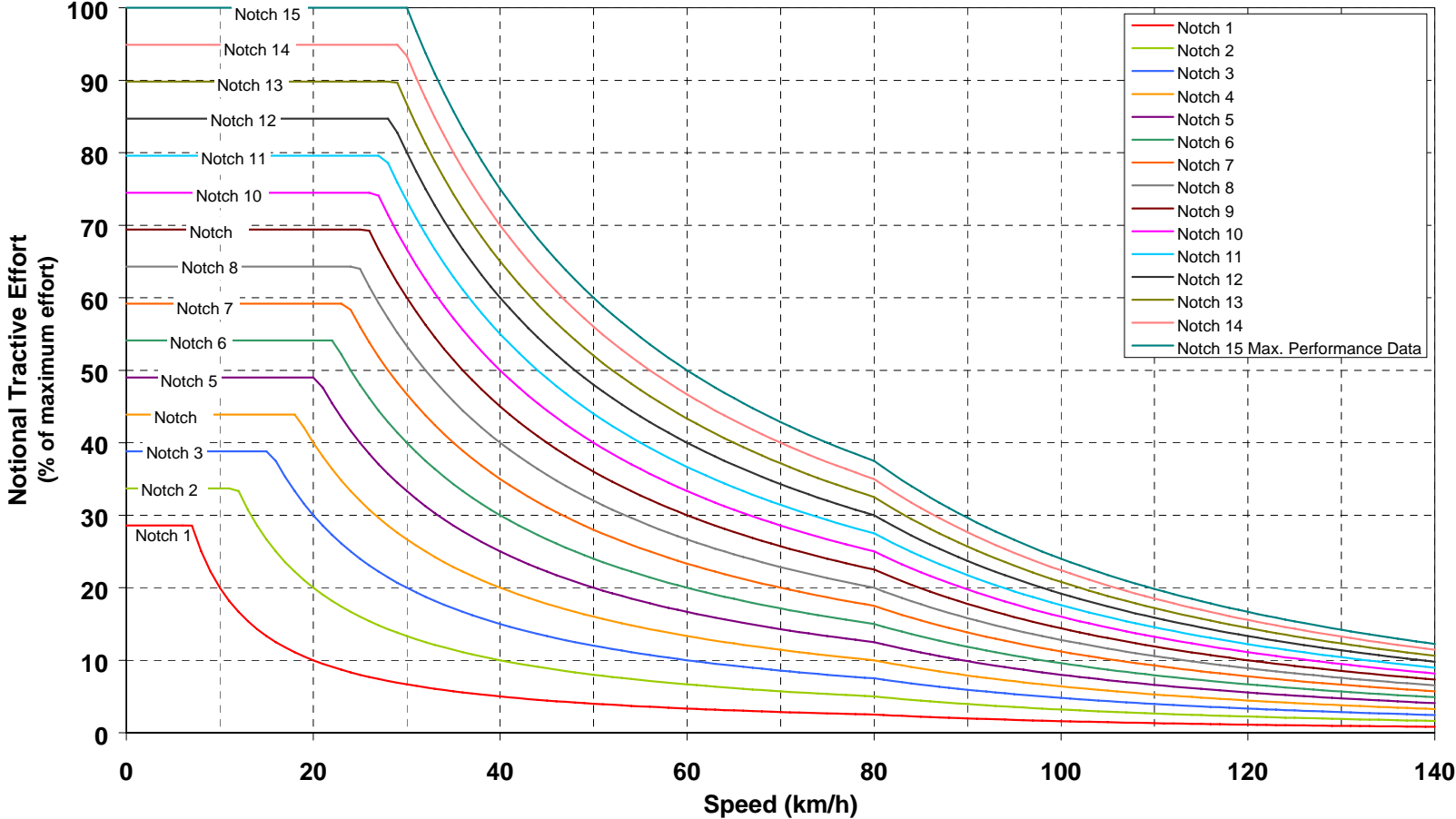
## Door Control Switches



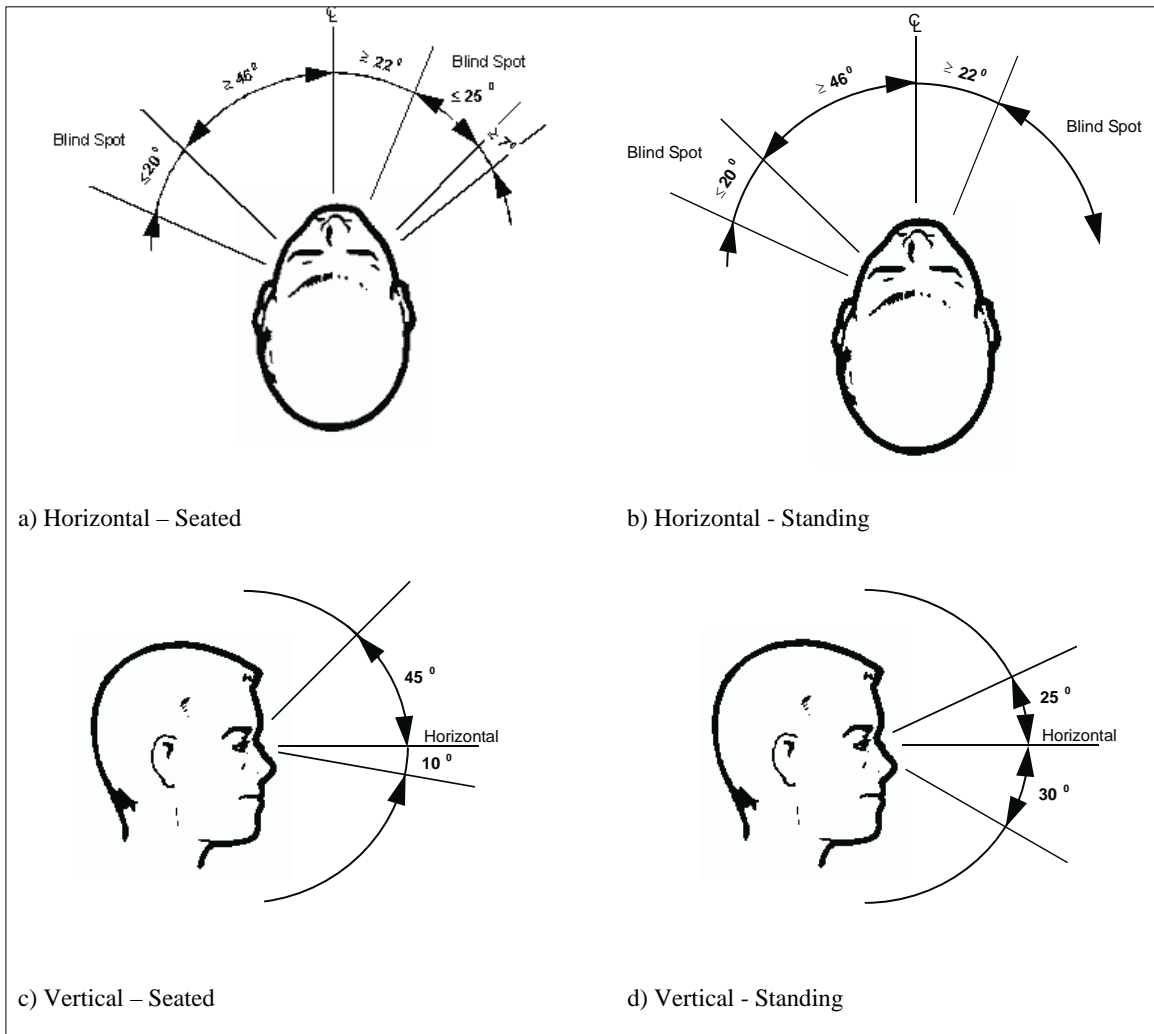
# APPENDIX S – TRACTION CONTROLLER POSITIONS AND POWER

## POWER NOTCH CHARACTERISTIC PATTERN REQUIRED

(Example shown for a 15-Notch power controller & minimum starting tractive effort that is 28.6 % of maximum effort)



# APPENDIX T – CREW VISIBILITY



**APPENDIX U – TRAIN EMERGENCY EQUIPMENT****Change Log**

<b>Issue</b>	<b>Date</b>	<b>Author</b>	<b>Change</b>
v5	CONTRACT		
v6	30/06/2009	ARJS	Formal inclusion of text changes arising from letter RC00273 dated 27/06/2007 – <i>Pre-agreed Variation</i> .
v7	02/09/2010	ARJS	Addition of text changes from RFTA: 00353



**Safety equipment locker and emergency equipment box**

The contents of each safety equipment locker shall include:

Letter RC00273	Item	End Crew Cab (quantity)	Guard's Cab (quantity)	
	RFTA 00353	Trip Gear hoses and spanners  To suit Trip Gear on Set	Sufficient for one (1) set of Trip Gear	-
Main reservoir hose  Including fittings		1	-	
Brake Pipe hose  Including fittings		1	-	
Brake hose spanners  48/53 mm AF, approximately 400 mm long		2	-	
Manual door opening/closing equipment and door locking bar  To suit all powered doors on Set including each of the Passenger bodyside doors and intercar access doors		1	4	
End emergency detrainment access equipment		1	-	
Safety barrier for end emergency detrainment access		1	-	
<del>Pantograph tie-down equipment</del>		<del>4</del>	<del>4</del>	
<del>Rope or other insulating material</del>		<del>1</del>	<del>4</del>	
Park Brake release equipment  To suit Park Brake on Set		1	4	
Track shortening clips  In accordance with RailCorp drawing D08641 and specification FE106		2 (Subject to change in emergency equipment box requirements by RailCorp)	2 (Subject to change in emergency equipment box requirements by RailCorp)	
Remote supply jumper		1	-	
Emergency equipment box		1	4	
RFTA 00353		Wooden chocks	2	
		Safety Vest (high visibility vest size XL)	1	

The contents of the emergency equipment box shall include:

Item	Quantity
Railway Fog Signals (in canister) In accordance with RailCorp specification C4750	12
Red and green flags In accordance with RailCorp drawing 206-928 item 5 (green) and 6 (red), without handles	2 red, 1 green
Track shortening clips In accordance with RailCorp drawing D08641 and specification FE106	1 (Subject to change in emergency equipment box requirements by RailCorp)



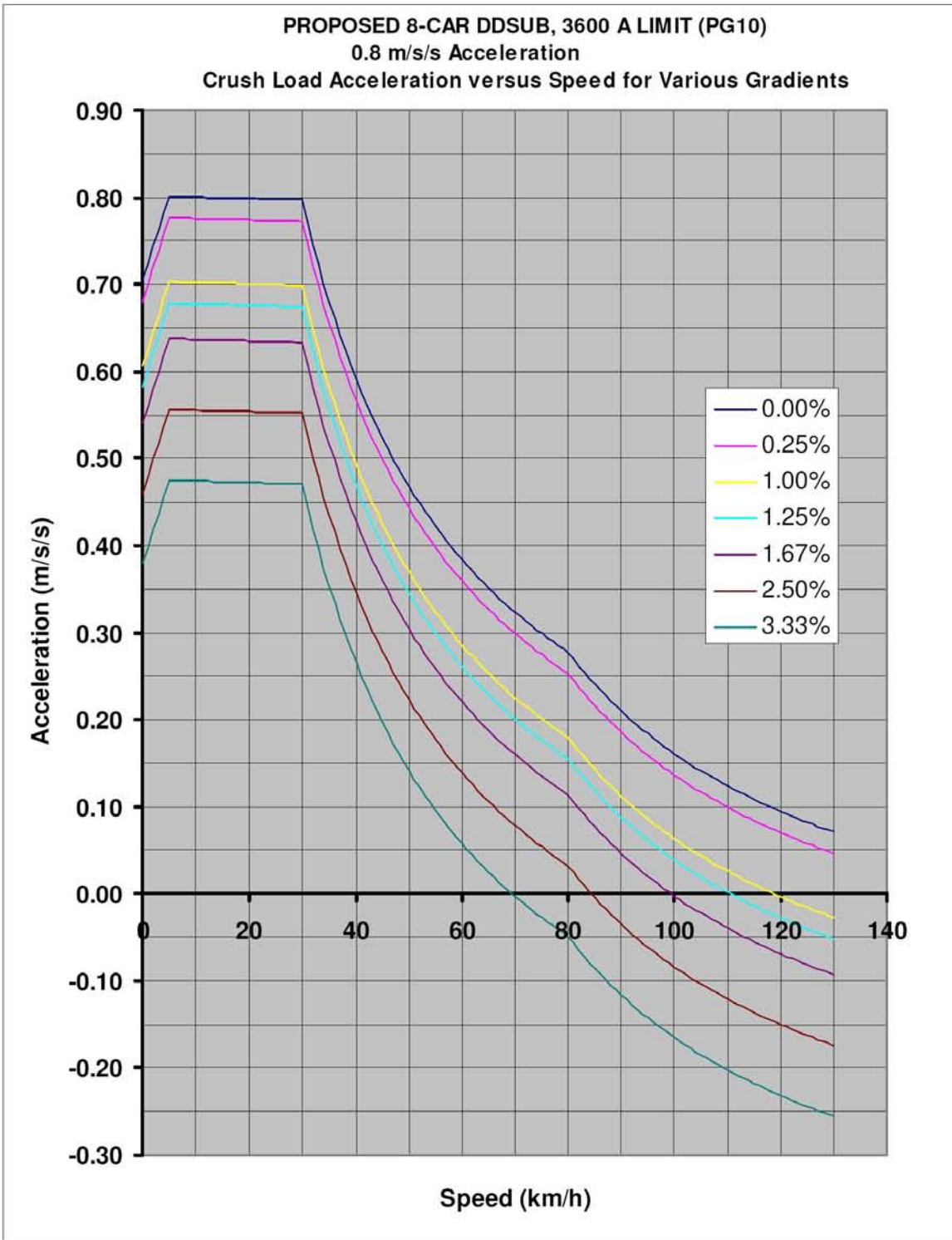
**Indicative layout of safety equipment locker**

## APPENDIX V – ACCELERATION PERFORMANCE

### Change Log

Issue	Date	Author	Change
v3	CONTRACT		
v4	21/04/2009	ARJS	Addition of text changes from RFTA Group 11: 00284

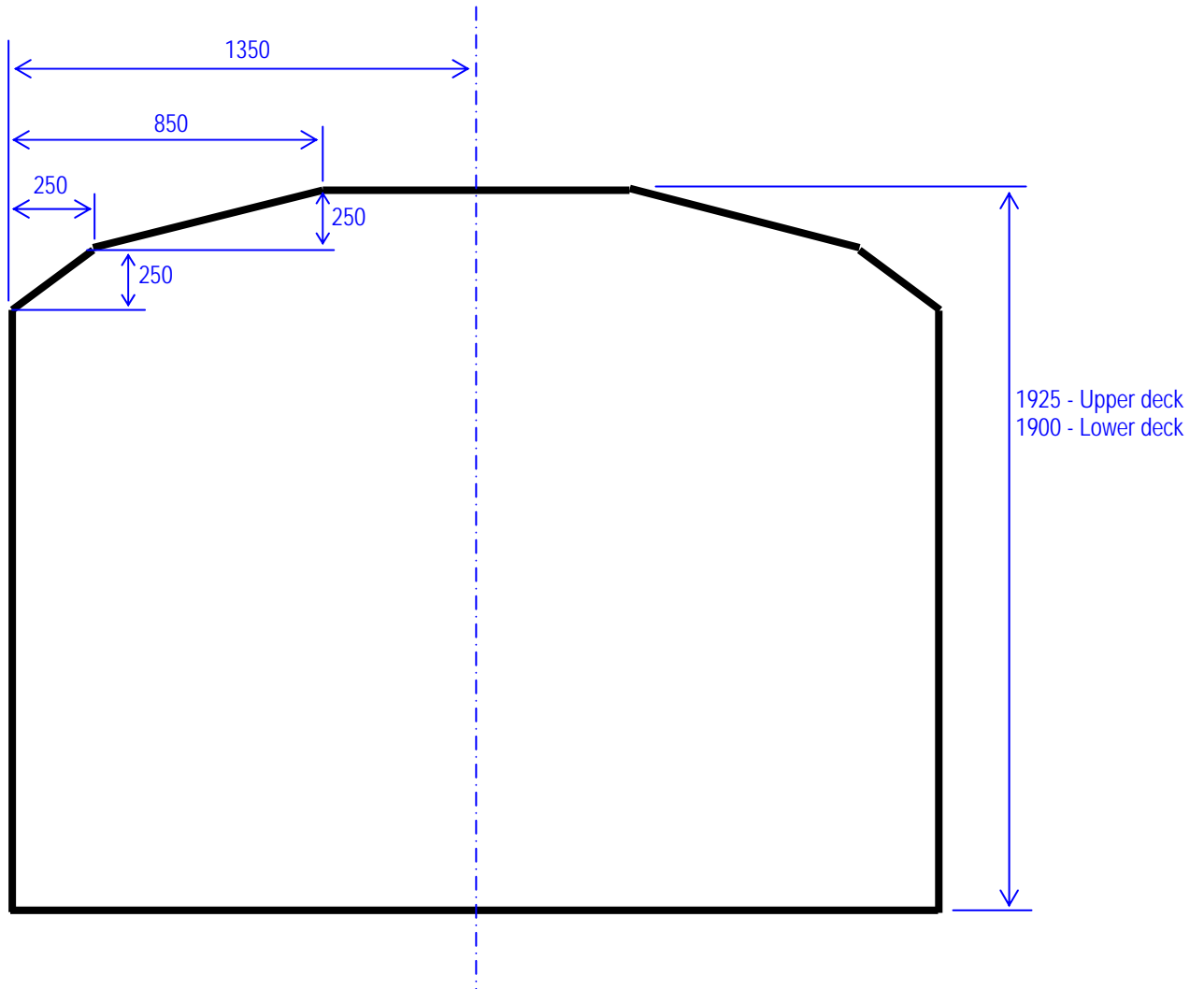
Double Deck



RFTA  
00284

[Graph 2 deleted]

# APPENDIX W – MILLENNIUM TRAIN INTERNAL PASSENGER COMPARTMENT DIMENSIONS



**Note:** DRAWING NOT TO SCALE. ALL DIMENSIONS MM

## **APPENDIX X – GUARD’S EMERGENCY COCK LOCKOUT**

The pages in Appendix X are a copy of a RailCorp Draft Engineering Modification instruction. The pages illustrate the Guard’s Emergency Lock – Out device, the method used to fit the device to Tangara and Millennium trains and modifications required to those trains to ensure that the device can be applied and securely locked.

The PPP train shall have similar features as the modified Millennium and Tangara trains and be compatible with the same lock-out device.

<b>STATE RAIL PASSENGER FLEET MAINTENANCE QUALITY AND TECHNICAL SUPPORT</b>		<b>Page: 2 of 8</b>
<b>ENGINEERING MODIFICATION</b>  <b>EM [Enter No]</b>		<b>[Enter Date]</b>  <b>ISSUE</b>
<b>HAZARD CODE:</b> <b>[Enter Hazard Code]</b>	<b>DRAFT</b>	<b>© Copyright State Rail Authority</b>
		<b>TECHNICAL MAINTENANCE CODE:</b> <b>[Enter TMC]</b>

**TITLE: FITMENT OF LOCKING POSTS FOR GUARD'S EMERGENCY  
COCK LOCKOUT ON TANGARA & MILENIUM DRIVING TRAILER CARS**

**CARS or EQUIPMENT AFFECTED:**

Tangara "T" Set Control Trailer Cars 6101 to 6275  
Tangara "G" Set Control Trailer Cars 6801 to 6841  
Millennium Control Trailer Cars 1001 to 1040

**SUMMARY/BACKGROUND:**

It is necessary for Equipment Examiners and other Maintenance staff to be able to ensure that a train cannot be moved when they are in a dangerous position such as under the train. This may be achieved by locking the Guard's Emergency Cock in the "APPLIED" position, thus venting the Brake Pipe to atmosphere and preventing a recharge.

**SAFETY REQUIREMENTS:**

**MATERIAL and SPECIAL TOOLS:**

Battery powered pistol drill; 11mm drill (or 27/64"); Centre punch or Bradawl.  
Template for Guard's Emergency Cock Locking Post Location.  
2 off Guard's Emergency Cock Locking Posts; 3/8" BSW Stainless Steel Nut, Spring Washer and Flat Washer  
Guard's Emergency Cock Lock (including MASTER LOCK 410 RED Blackwoods Pt No. 01152063)

**COST of MODIFICATION:**

<b>Total estimated time per Car:</b>		<b>Rate:</b>
<b>Completion by:</b>		
<b>Estimated cost:</b>		
	<b><u>Per Car</u></b>	<b><u>Total</u></b>
Direct material cost:		
Special tools cost:		
Labour cost:		
	<b>TOTAL COST:</b>	

**DESCRIPTION:**

1. Place the guard's Emergency Cock Handle in the "APPLIED" (horizontal) position.

**ENGINEERING MODIFICATION**  
[Enter No]

© Copyright  
State Rail Authority

[Enter Date]  
**ISSUE**

2. Draw a Vertical pencil line across the handle at 95mm from the centre of the cock spindle.
3. Place the rectangular hole of the Locking Post Location Template (see attached drawing) over the handle so that the two small location holes are above the handle and against the rear wall.
4. Using a tri-square, ensure that the Template is at right angles to the handle and mark the two holes through the template onto the wall.
5. Centre pop the hole centres or mark with a bradawl taking care not to crack the wall material.
6. Open the cupboard behind the Guard's Emergency Cock and ensure that it will be safe to drill into the wall (check for wires and pipework).
7. Drill the 2 holes 11mm dia. or 27/64" taking great care not to drill pipework or electrical wires inside the cupboard. NOTE: Ensure that shavings do not fall into switches or relays inside the cupboard (cover with a sheet of paper and sticky tape). Debur the holes.
8. Fit the 2 Guard's Emergency Cock Locking Posts and secure with a flat washer, spring washer and 3/8" BSW stainless steel nut ensuring that the holes that are drilled through the locking posts are both mounted HORIZONTALLY.
9. Remove the paper and sticky tape used to protect switches etc.
10. Use a Guard's Emergency Cock Lock to test that the posts are in the correct position and that the lock is lockable. NOTE: It is EXTREMELY IMPORTANT to test this as this is a safety device to protect workers under the train.
11. Enter the car details against this mod. on METRE. MOD. XXXXX

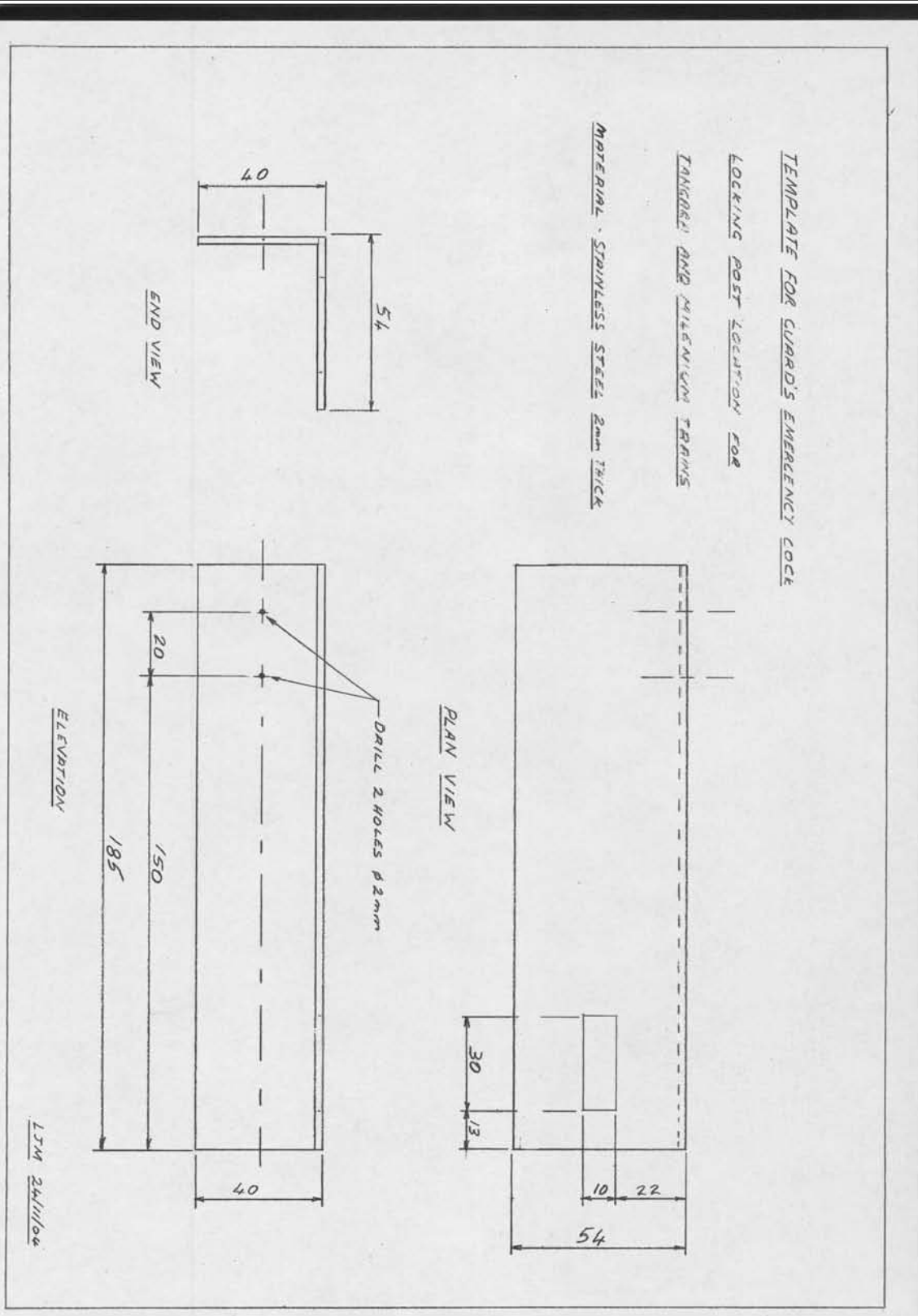


**ENGINEERING MODIFICATION**

[Enter No]

© Copyright  
State Rail Authority

[Enter Date]  
ISSUE



**ENGINEERING MODIFICATION**  
[Enter No]

© Copyright  
State Rail Authority

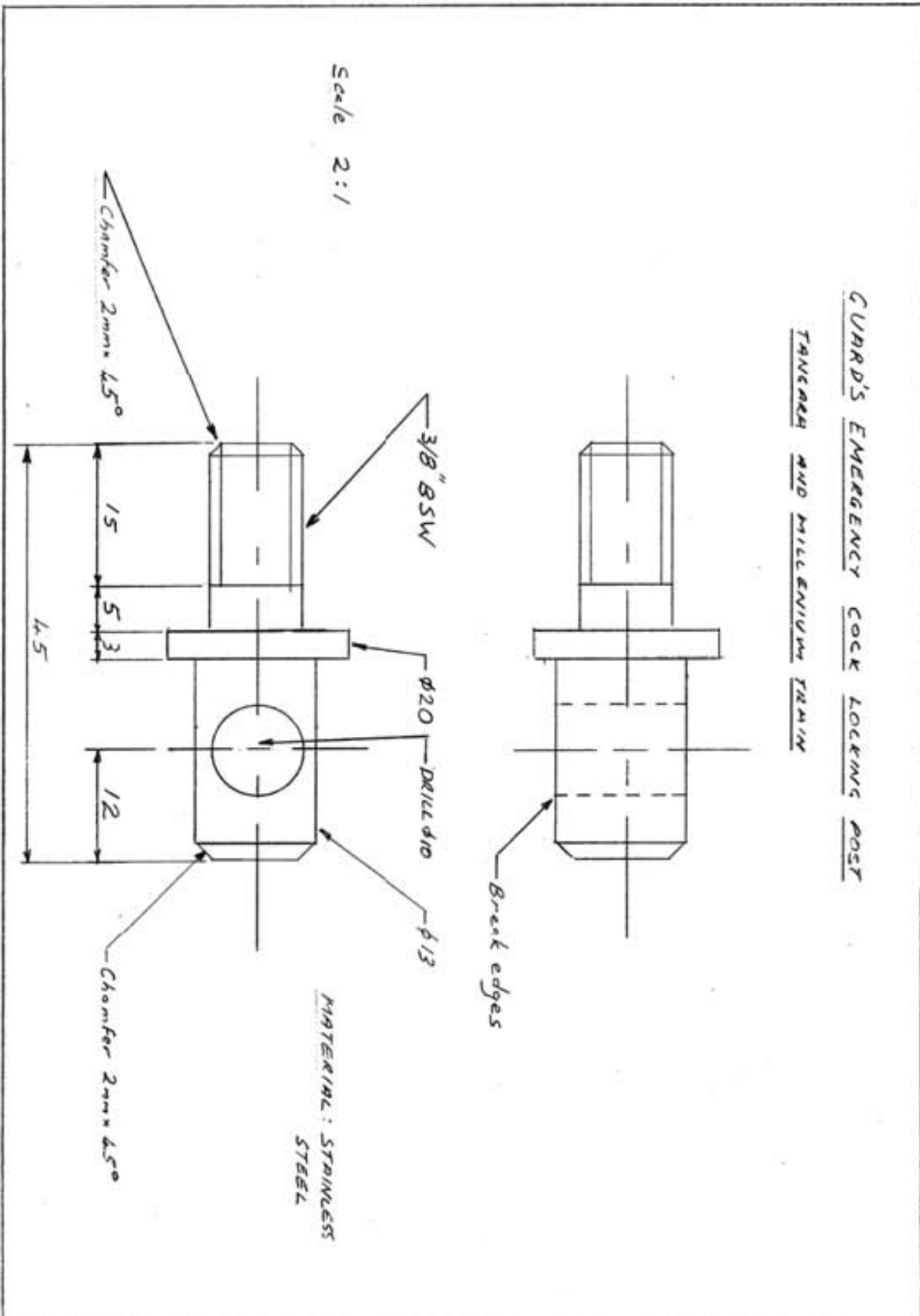
[Enter Date]  
**ISSUE**

Empty content area for the Engineering Modification issue.

**ENGINEERING MODIFICATION**  
[Enter No]

© Copyright  
State Rail Authority

[Enter Date]  
ISSUE





**ENGINEERING MODIFICATION**  
[Enter No]

© Copyright  
State Rail Authority

[Enter Date]  
**ISSUE**

Large empty rectangular area for content.

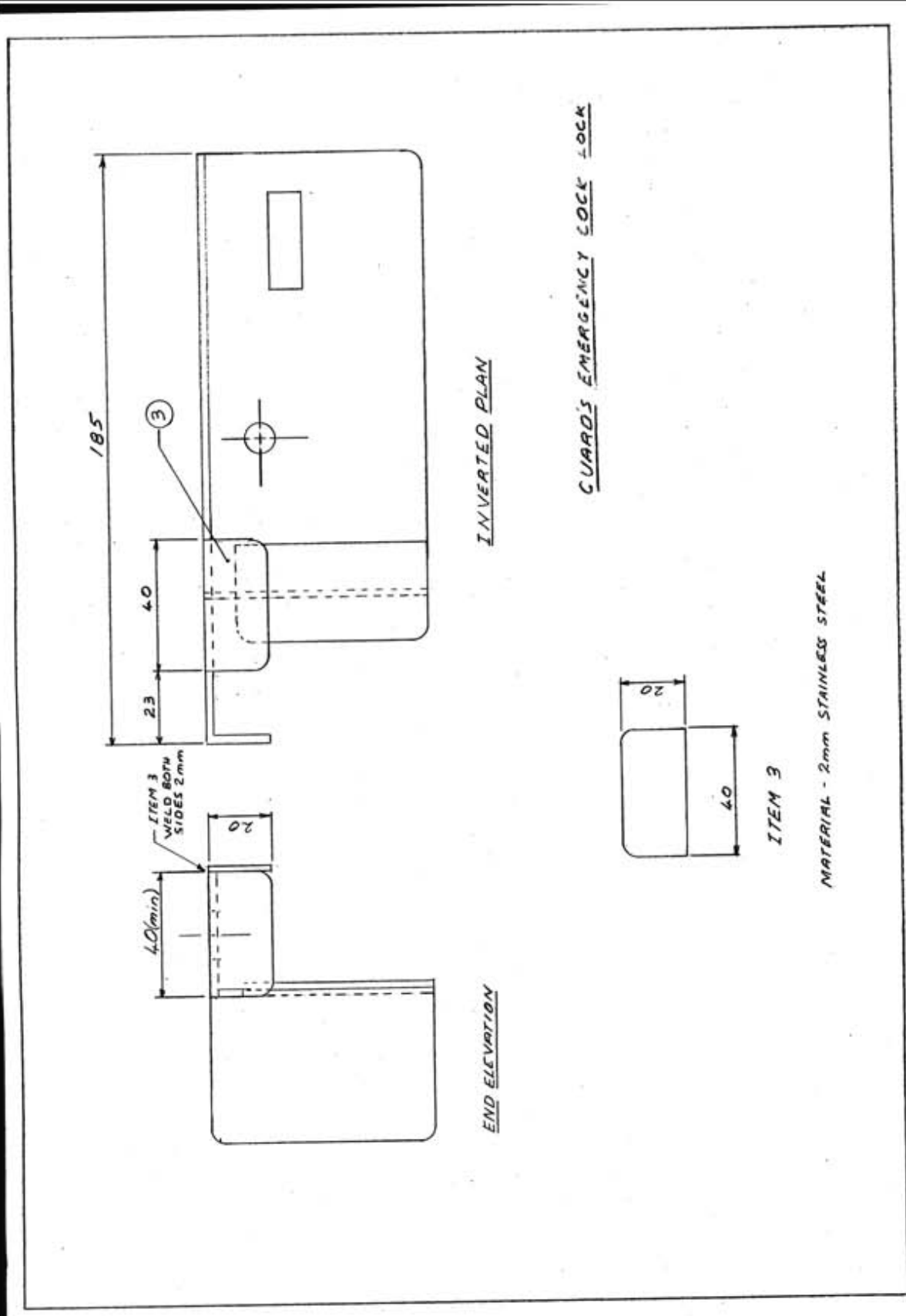
**ENGINEERING MODIFICATION**

[Enter No]

© Copyright  
State Rail Authority

[Enter Date]

ISSUE





## APPENDIX Z – MINIMUM TRACTION EFFICIENCY

### Change Log

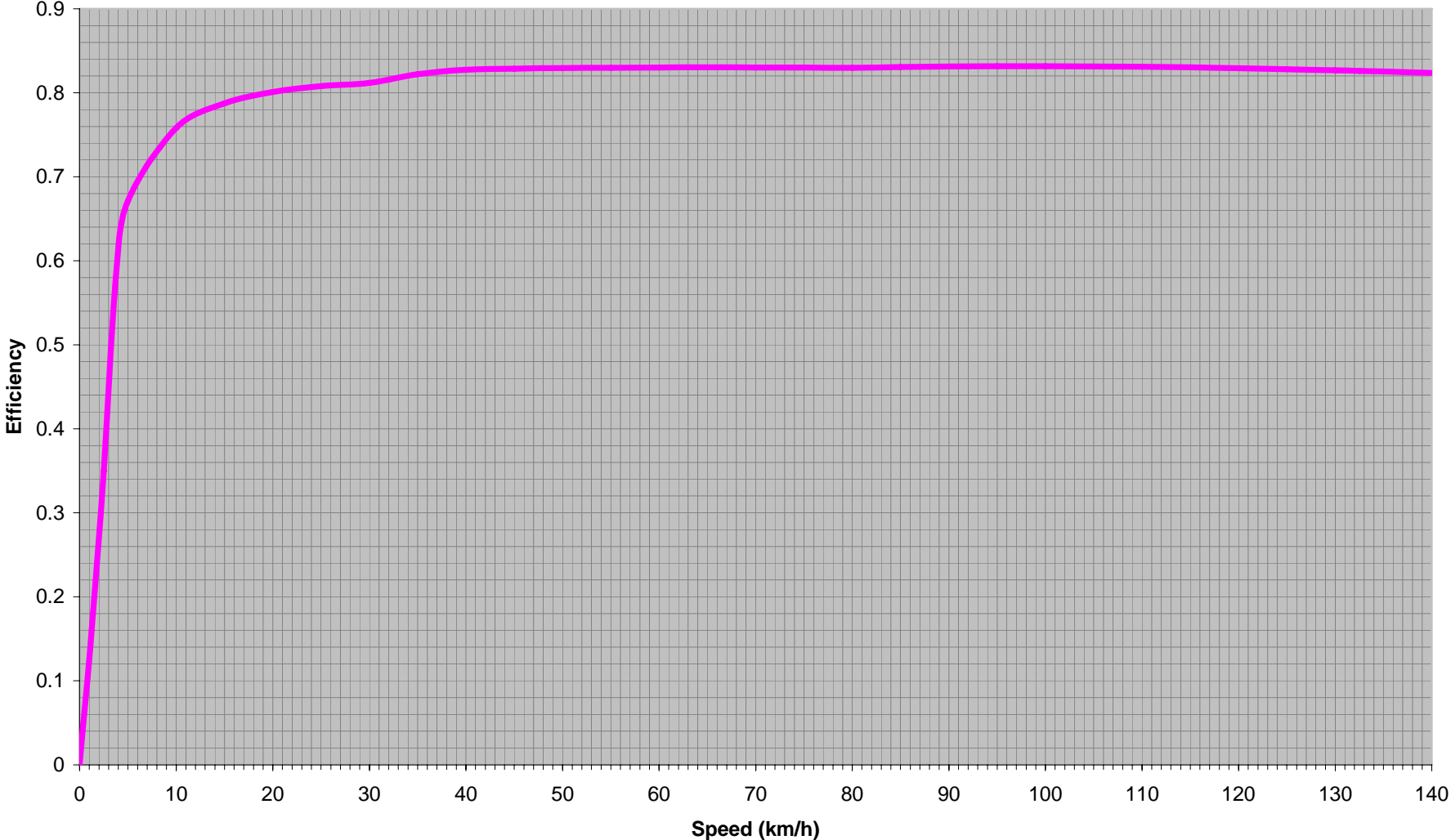
Issue	Date	Author	Change
v2	CONTRACT		
v3	30/06/2009	ARJS	Addition of text changes from RFTA Group 12: 00166



RFTA  
00166

[Note graph replaced]

**Minimum Traction Efficiency of PPP Train [RFTA 00166]**



**APPENDIX AA - EDR FUNCTIONALITY TABLE****Change Log**

<b>Issue</b>	<b>Date</b>	<b>Author</b>	<b>Change</b>
v1	15/06/2009	ARJS	New Appendix arising from RFTA: 00022
v2	30/06/2009	ARJS	Addition of text changes from RFTA: 00198

Blank cells indicate the feature is not required for the EDR at this location

		Type	Crew Cab Transverse		Crew Cab bodyside		Passenger bodyside		Intercar		
		Location	Cab Side	Saloon Side	Internal	External	Internal	External	Gangway	Saloon	
	All EDRs	EDRs active in the following conditions: Main Power, Pneumatic, or Battery Power Loss to Vehicle Power Loss to EDR Controller	<b>Push Bar so not covered by this table</b>	✓	✓	✓	✓	✓	✓	✓	
				✓	✓	✓	✓	✓	✓	✓	
		<u>EDRs Inactive due to Crew Override</u>		✓ <sup>1</sup>			✓				
RFTA 00198	Active EDRs	Always Active						✓ <sup>23</sup>	✓ <sup>23</sup>		
RFTA 00198		EDRs Always Active unless Deactivated by either:		>5km/h		✓	✓	✓	✓		
RFTA 00198				Stabled				Note <sup>12</sup>	✓		
RFTA 00198	Inactive EDRs	EDRs Always Inactive unless, ≤5km/h and activated by either: <u>Note 1</u>		2nd Stage Fire Alarm	✓						
				PEI Escalation	✓						

RFTA  
00198

RFTA  
00198

RFTA  
00198

RFTA  
00198

		Type	Crew Cab Transverse		Crew Cab bodyside		Passenger bodyside		Intercar		
		Location	Cab Side	Saloon Side	Internal	External	Internal	External	Gangway	Saloon	
Normal State Features	Sealing device		<b>Push Bar so not covered by this table</b>	✓	✓	✓ (Lock)	✓	✓ (Self Closing)	✓	✓	
	Crew Alarm	Stage 1		✓	✓		✓		✓ (Nightsafe / Isolated only)	✓ (Nightsafe / Isolated only)	
		Stage 2		✓	✓	✓	✓	✓	✓ (Nightsafe / Isolated only)	✓ (Nightsafe / Isolated only)	
	<u>Crew Override indicator</u>			<u>✓</u> <sup>1</sup>				<u>✓</u>			
	<u>Local alarm at Stage 1</u>			<u>✓</u>				<u>✓</u>		<u>✓</u>	<u>✓</u>
	<u>Local EDR Stage 2 Activation available visual indicator</u>			<u>✓</u>				<u>✓</u>			
	<u>Timed self reset</u>									<u>✓</u>	<u>✓</u>
	PEI Activation at both Stage 1 and Stage 2			✓				✓			
	Event recorded on CCTV			✓				✓	✓	✓	✓
	Active CCTV Image on Crew monitor			✓				✓	✓	✓ (Nightsafe / Isolated only)	✓ (Nightsafe / Isolated only)

		Type	Crew Cab Transverse		Crew Cab bodyside		Passenger bodyside		Intercar		
		Location	Cab Side	Saloon Side	Internal	External	Internal	External	Gangway	Saloon	
	Opens Door when Vehicle on Side		<b>Push Bar so not covered by this table</b>	✓	✓	✓	✓	✓	✓	✓	
	Activation recorded by TOS and Event Recorder	Stage 1		✓		✓		✓		✓	✓
		Stage 2		✓	✓	✓	✓	✓	✓	✓	✓
Stabled State Features	Immediate availability for Stage 2 Activation following Stage 1 Activation when configured by maintenance to be active in stabled state.							✓			
	<u>Local EDR Stage 2 Activation available visual indicator</u>							✓			

RFTA  
00198

RFTA  
00198

**Note 1:** Refer to clause 6.7.2.3.5 (i) and configurable option clause 6.7.2.3.5(ii)

**Note 42:** Internal Passenger Bodyside EDRs are inactive when the train is Stabled, but are able to be reconfigured to be active. Refer to Clause 6.7.2.3.1.

**Note 23:** Whilst an Intercar Door is isolated, the Intercar Door EDRs shall be configurable to be either active or inactive through a maintenance task. Refer to Clause 6.7.2.3.3.