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Document Number	Title	Rev	Date
MP C0-00047	GENERAL ARRANGEMENT CLASS 47 RETB	P1	08/01/15
MP-C0-00048	ROOF ANTENNAS INSTALLATION CLASS 47	P1	08/01/15
MP-C0-00054	CDR HANDSET AND SPEAKER INSTALLATION CLASS 47 RETB	P1	08/01/15
MP-C0-00055	JUNCTION BOX SUB ASSEMBLY CLASS 47 RETB	P1	08/01/15
MP-C0-00056	MISCELLANEOUS DETAILS CLASS 47 RETB	P1	08/01/15
MP-C0-00057	JUNCTION BOX INSTALLATION CLASS 47 RETB	P1	08/01/15
MP-C0-00058	CLASS 47 NRN AND RETB/NG SCHEMATIC	P1	08/01/15
MP-C0-00059	CLASS 47 RETB/NG WIRING DIAGRAM	P1	08/01/15
MP-C0-00072	GPS ANTENNA DETAILS CLASS 47 AND 57 RETB	P1	08/01/15
MP-C0-00091	JUNCTION BOX SUPPORT FABRICATION ASSEMBLY CLASS 47 RETB	P1	08/01/15
MP-C0-00092	JUNCTION BOX COVER ASSEMBLY AND DETAILS CLASS 47 RETB	P1	08/01/15
MP INV 001	NG RETB Materials Inventory List	4	28/11/14
VMP-RETB-005	Class 47 RETB Installation Modification and Test Procedure	Issue 1 AD2	January 2015
MP TECHREP 032	NG RETB Class 47 Compliance for NG RETB Installation	2	12/01/15
MP HAZID 005	Hazard Identification Check List	1	November 2014
Ref. MP HAZ ID 005	Hazard Closeout Sheet	1	November 2014
DG8-CALC-00327	Structural Calculations	A	01/12/14

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Superseded Document Number	Title	Rev	Date
VMP-RETB-005	Class 47 RETB Installation Modification and Test Procedure	AD1	01/12/14
MP TECHREP 032	NG RETB Class 47 Compliance for NG RETB Installation	1	28/11/14

Reason issued (tick box)	
For review by telent	x
For telent information only	

Proposed distribution once approved (tick boxes)	
RETB Stakeholders	x
Network Rail project	
Network Rail Ergonomics	
CDL	x
(other)	

The document attached and detailed above either supersedes controlled documents currently in your possession or is new to you. Please replace the relevant documents and destroy any outdated copies.

Please sign, scan and email back to aura.balandiene@multipulse.com **within 48 hrs of receipt.**

The document listed above has been received and any superseded versions destroyed.

Name KEVIN AIRES Signature K.F Aires Date 23/1/15

Telent confirmation that the document listed above can now be distributed externally.

Neil Newland-Smith, telent CEM Signature N D N-S Date 23/1/15

NEXT GENERATION RETB

CLASS 47 COMPLIANCE FOR NEXT GENERATION RETB INSTALLATION

Ref: MP TECHREP 032

Issue: 2

Date: 12/01/15

Endorsement and Authorisation

Prepared by:

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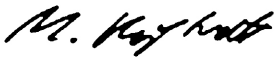

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Issue Record

Issue	Date	Comment
1	28/11/14	First Issue
2	12/01/15	Amended following detailed design review

Contents

1 Introduction

Network Rail are in the process of developing a replacement RETB (Radio Electronic Token Block) radio system for the Far North Line (FNL) and West Highland Lines (WHL) in Scotland. After a life extension of infrastructure systems, the Next Generation RETB (RETB NG) project is planning to replace the radio system element (NRN) as the frequencies used are due to be returned to Ofcom at the end of 2015. This requires a new train radio and token exchange unit to be installed in all driving cabs of vehicles used on the FNL and WHL.

Multipulse Electronics Limited (Multipulse) has recently been awarded the contract to undertake the installation design, approvals and physical installation of the trainborne equipment. Multipulse has subsequently contracted the installation design aspects of the project to dg8 design and engineering limited (dg8), for the purposes of this document all dg8 employees will be known as the Multipulse Installation Design Team.

The Multipulse Installation Design Team is an ISO 9001:2008 and ISO14001:2004 accredited body, and undertakes a wide variety of installation design and approval projects for the railway industry.

2 Scope

This document provides the Railway Group Standards compliance responses for the Class 47 Locomotives, fitted with the RETB NG equipment.

3 Abbreviations

CDL	Comms Design Ltd
CDR	Combined Cab Display Unit and Radio
CDSR	Concept Design and Survey Report
CDU	Cab Display Unit
CE	Conformity Engineer
CSR	Cab Secure Radio
DeBo	Designated Body
DMU	Diesel Multiple Unit
EIP	Ergonomics Integration Plan
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
FNL	Far North Line
FOC	Freight Operating Company
FoC	First of Class
FoT	First of Test
GPS	Global Positioning System
GSM-R	Global System for Mobile communications - Railways
ICD	Interface Control Document
NoBo	Notified Body
NRN	National Radio Network
ORR	Office of Rail Regulation
OTDR	On Train Data Recorder
OTMR	On Train Monitoring and Recording
PACS	Propelling Advisory Control System
PSU	Power Supply Unit
RETB	Radio Electronic Token Block
RETB NG	Radio Electronic Token Block Next Generation
RF	Radio Frequency
RIA	Railway Industry Association
ROGS	Railways and Other Guided Systems regulations
TPWS	Train Protection And Warning System
VHF	Very High Frequency (Radio Frequency Band)

4 Reference Documents

Ref No	Document No	Title
1	ICD-1051-01	RETB INTERFACE CONTROL DOCUMENT
2	DG8-CALC-00327	CLASS 47 RETB INSTALLATIONS
3	MP INV 001	NEXT GENERATION RETB MIL
4	MP HAZ ID 005	CLASS 47 HAZARD ID
5	VMP/RETB/005	CLASS 47 RETB INSTALLATION MODIFICATION AND TEST PROCEDURE
6	GE/RT8015	ELECTROMAGNETIC COMPATIBILITY BETWEEN RAILWAY INFRASTRUCTURE AND TRAINS - ISSUE 1
7	GK/RT0036	TRANSITIONS BETWEEN SIGNALLING SYSTEMS - ISSUE 2
8	GK/RT0055	BLOCK SYSTEM INTERFACE REQUIREMENTS - ISSUE 1
9	GK/RT0094	TRAIN VOICE RADIO SYSTEMS - ISSUE 1
10	GM/RT2004	RAIL VEHICLE MAINTENANCE - ISSUE 5
11	GM/RT 2100	REQUIREMENTS FOR RAIL VEHICLE STRUCTURES -ISSUE 5
12	GM/RT2130	VEHICLE FIRE, SAFETY AND EVACUATION-ISSUE 4
13	GM/RT2149	REQUIREMENTS FOR DEFINING AND MAINTAINING THE SIZE OF RAILWAY VEHICLES - ISSUE 3
14	GM/RT2304	EQUIPOTENTIAL BONDING OF RAIL VEHICLES TO RUNNING RAIL POTENTIAL - ISSUE 3
15	MP-C0-00047	GENERAL ARRANGEMENT CLASS 47 RETB
16	MP-C0-00048	ROOF ANTENNA INSTALLATION CLASS 47 RETB
17	MP-C0-00054	CDR, HANDSET AND SPEAKER INSTALLATION CLASS 47 RETB
18	MP-C0-00055	JUNCTION BOX SUB-ASSEMBLY CLASS 47 RETB
19	MP-C0-00056	MISCELLANEOUS DETAILS CLASS 47 RETB
20	MP-C0-00057	JUNCTION BOX INSTALLATION CLASS 47 RETB
21	MP-C0-00058	SCHEMATIC CLASS 47 RETB
22	MP-C0-00059	WIRING DIAGRAM CLASS 47 RETB
23	MP-C0-00019	CL.47 - ERGONOMIC EVALUATION OF CDR UNIT LOCATION 95TH PERCENTILE MALE AND 5TH PERCENTILE FEMALE
24	MP-C0-00020	CL.47 - ERGONOMIC EVALUATION OF HANDSET LOCATION 95TH PERCENTILE MALE & 5TH PERCENTILE FEMALE
25	MP-C0-00021	CL.47 – CONCEPT ROOF ANTENNA JUNCTION BOX LOCATION AND CABLE ROUTING

26	MP-C0-00072	GPS ANTENNA DETAILS CLASS 47 AND 57
27	MP-C0-00091	JUNCTION BOX SUPPORT FABRICATION ASSEMBLY CLASS 47 RETB
28	MP-C0-00092	JUNCTION BOX COVER ASSEMBLY AND DETAILS CLASS 47 RETB

5 Compliance Requirements and Commentary

Table A - GE/RT8015 - Electromagnetic Compatibility between Railway Infrastructure and Trains - Issue 1

Clause	Topic	Response
All	All	It is reasonable to conclude that the only credible method of coupling energy into Network Rail infrastructure is through EM radiation. There is a presumption that if the RETB conforms to EN50121-3-2 and is installed in line with OEM recommendations then there are unlikely to be any compatibility issues with the infrastructure or other locomotive mounted electrical systems. The exception is the specific emission from the antenna, and is addressed by the physical separation between the RETB antenna and other train mounted systems.

Table B - GK/RT0036 - Transitions Between Signalling Systems - Issue 2

No installation requirements

Table C - GK/RT0055 - Block System Interface Requirements - Issue 1

No installation requirements

Table D - GK/RT0094 - Train Voice Radio Systems - Issue 1

Clause	Topic	Response
2.2.1.1	A train voice radio shall be operable from each cab that is required to be used as a driving cab of a train in service.	The installation has been completed in accordance with Interface Control Document ICD-1051-01 [Reference 1]

Table E - GM/RT2004 - Rail Vehicle Maintenance - Issue 5

Clause	Topic	Response
3.2.6.4	The maintenance requirements for trainborne signalling and communication equipment shall be documented. They shall form part of the rail vehicle maintenance plan for the rail vehicle in which the equipment is mounted.	Maintenance information for the Class 47s to be updated to include new equipment.
3.2.6.5	The procedures to ensure configuration control of both software and hardware of the trainborne signalling and communications equipment shall be documented in the maintenance plan.	Maintenance information for the Class 47s to be updated to include new equipment.

Table F - GM/RT 2100 - Requirements for Rail Vehicle Structures - Issue 5

Clause	Topic	Response
3.2	3.2.1 Equipment attached to vehicle bodies shall be designed according to the inertia load values set out in BS EN 12663-1:2010 or BS EN 12663-2:2010 for the relevant vehicle category unless otherwise set out in this document. 3.2.2 The ultimate strength of the equipment attachments shall be consistent with the inertia load values set out in BS EN 12663-1:2010 or BS EN 12663-2:2010 or the maximum mean deceleration levels for the collision scenarios set out in BS EN 15227:2008, whichever is the greater. 3.2.3 The equipment attachment strength shall be formally assessed unless, for minor items of equipment, it can be demonstrated that:	Structural calculation DG8-CALC-00327 [Reference 2] confirms that the installation meets the structural requirements of GM/RT 2100 Issue 5.

	a) For a given type or method of attachment, items at or below a given mass will be securely retained for the acceleration loads specified. Or b) A minor item is sufficiently contained or enclosed to prevent it becoming a potential hazard if detached in the event of a collision or derailment or for any other reason. Or c) Service experience in an equivalent or more demanding environment has shown the installation to be satisfactory. 3.2.4 Where the failure of an individual mounting could lead to the overload and the potential sequential failure of adjacent mountings, or where a single mounting is used and a resulting failure will create a hazardous situation, secondary fasteners, retention devices or some other equivalent means shall be provided, taking into account the likelihood of detection of an initial failure when in service or during maintenance inspections. 3.2.5 Locally generated accelerations, forces and resonances acting within and on equipment shall be accounted for as well as the specified proof and fatigue inertia loads. 3.2.6 Sources of locally generated accelerations, forces and resonances to be considered for proof and fatigue loads shall include, but not be limited to: a) Engines, gearboxes, cooler groups and hydrostatic drives. b) Body mounted traction motors. c) Transmission units. d) Suspension elements (for example dampers, anti-rollbars, traction linkages). e) Air compressors. f) Door operating equipment. g) Gangways. h) Air conditioning systems. 3.2.7 The fatigue design life for equipment attachments shall be determined. If the fatigue design life is less than the design life of the vehicle, this shall be accounted for in inspection, maintenance and overhaul procedures, whereby life expired items are replaced.	

6.9	6.9.1 General requirements 6.9.1.1 In accordance with 6.1.6, cabs and areas occupied by traincrew shall be assessed for the potential for injury due to secondary impact in the event of a collision or derailment. 6.9.1.2 The cab seat zone (the area of the cab in which the driver is seated) shall be dynamically tested in accordance with Appendix F to simulate a frontal collision and shall give a satisfactory injury criteria assessment as set out in Appendix H.1 for a 50th percentile male ATD located in the driving position.	The profile of the RETB equipment has not changed. Bracketry within the vehicle has been developed to reduce sharp corners and edges but are considered to present a low risk of secondary impact.

Table G - GM/RT2130 - Vehicle Fire, Safety and Evacuation - Issue 4

Clause	Topic	Response
2.4.4	The measures contained in BS 6853:1999 section 5 relating to design considerations with the aim of protecting passengers and staff in rail vehicles in the event of a fire on board shall apply to all categories of rail vehicle. The objectives are to minimise the risk of a fire starting, to delay fire development and to control the spread of fire products through the rail vehicle.	The fire barrier has not been penetrated.
2.11.1.1	When engineering change occurs, subject to compliance with fire performance and testing requirements of any parts of a vehicle repalced on a fleet basis, then: a) The areas subject to change shall meet the requirements of the applicable parts of the GM/RT2130 Standard. Or b) The net effect of the changes shall be such that the performance of the vehicle is not degraded in terms of fire initiation and development. Or c) Where the level of amenity in the vehicle is being increased by the addition of more seats, tables, luggage	MP INV 001 [Reference 3] confirms that the equipment meets the fire propagation requirements.

	racks, etc the fire performance of the newly introduced items shall be at least that of the existing items in the vehicle.	

Table H - GM/RT2149 - Requirements for Defining and Maintaining the Size of Railway Vehicles - Issue 3

Clause	Topic	Response
6.1	The envelopes defining the maximum movements of the vehicle under normal service and fault/failure conditions, shall, unless agreed otherwise with the infrastructure controller, be in the form of swept envelopes appropriately detailed to permit absolute gauging. These shall be derived by determination of the vehicle characteristics in absolute dimensional terms as defined in section B7 of this document. The swept envelope shall be determined relative to the nominal centreline of the track and the plane of the rail, and shall assume a fixed track. The vehicle designer is not required to include any allowances for track tolerances and rail wear, except as specifically required by section B7.3. All positional tolerances and allowances for rail wear are included in the infrastructure's calculation of clearances as required by GC/RT5212. Where specifically agreed with the infrastructure controller, it is permissible to use one of the following methods as a substitute: a) reference to a standard vehicle gauge as defined in section B8 of this document b) reference to a comparator vehicle as defined in section B9 of this document. Where either method a) or b) above are used to define the envelope of the vehicle, the clearance requirements shall	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].

	be deemed to be implicit in the gauge or reference vehicle agreed. Irrespective of the method used, except with the possible exception of the widely applicable W6a gauge, the train operator is advised (though not required) to define the vehicle in sufficient detail to facilitate subsequent transfer to routes where absolute gauging is required.	
6.4	The envelopes of the vehicle, by whichever method established, shall be maintained throughout its operational life by means of maintenance procedures that take full cognisance of the factors identified in section B6.6 of this document as influencing the swept envelopes of the vehicle and their limiting or maximum values for example limits of wear on suspension components.	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].
6.6	The mandatory limits of wear and maximum tolerances specified for all components, assemblies and systems influencing the degree of dynamic movement of the vehicle shall be reviewed, and those combinations identified as having a significant probability of occurrence shall be taken into account in the determination of each vehicle swept envelope.	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].
8.3	The vehicle under consideration shall not infringe the standard vehicle gauge unless the requirements of section B8.4 are met. Where such infringements are accepted, operational restrictions may result. Vehicles of any type may be built to any of the standard vehicle gauges providing they fully comply with the requirements of the chosen standard vehicle gauge. It is permissible for the infrastructure controller to develop additional gauges as circumstances necessitate and the requirements for the development of such standard vehicle gauges are set out in GC/RT5212.	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].

13.1	The train operator shall submit the following to a Conformance Certification Body (CCB) under the process for obtaining a Certificate of Conformance - Design.	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].
13.1.1	a) confirmation from the infrastructure controller that the method used for determination of the vehicle envelopes is compatible with the definition of the proposed route(s), as indicated in section B6.1 b) drawings, calculations, or other references, as appropriate, supporting the data c) evidence that tolerances and limits of wear, beyond which the vehicle would cease to be compliant with the declared envelope, have been identified and recorded for incorporation in the Maintenance Plan for the vehicle under the requirements of GM/RT2000 and GM/RT2004 d) the mass of all principal vehicle components, broken down typically into such major items as vehicle body, bogie sprung mass, wheelset mass, as appropriate. Where appropriate, separate values shall be provided for all relevant operating and loading conditions	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].
13.1.2	The following data shall be provided: a) a list of the critical features of the proposed routes influencing the accuracy and scope of the swept envelope determination b) an indication and justification of the worst cases considered in determining the swept envelopes, supported by a probability analysis of the cases considered in selecting the significant worst case(s) c) the swept envelope data relevant to the scope of required gauging acceptance as defined in section B13.2	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].

	of this document d) a detailed listing of all vehicle parameters and vehicle characteristics which are capable of influencing the size of the swept envelopes of a vehicle, identifying the numerical value of each parameter, including: i) the nominal value ii) the tolerance band iii) probability distribution (if appropriate) e) the inertias of the vehicle body, bogies (excluding wheelsets) and Wheelsets in yaw, pitch and roll f) the centre of mass of all principal vehicle components. Where appropriate, separate values shall be provided for all relevant operating and loading conditions g) suspension system linear or rotational force generating elements which produce forces or torques directly proportional to the relative displacement or velocity between the end points of the element h) suspension system linear or rotational force generating elements which produce forces or torques which are not directly proportional to the relative displacement or velocity between the end points of the element. Typical examples are bump and lift stops, dampers with blow-off characteristics, or hysteresis caused by friction i) other vehicle specific parameter types where appropriate for specific vehicle configurations which incorporate such elements as: i) tilt systems, ii) active suspension elements, iii) articulation, iv) hold off devices, v) other novel features.	
13.1.3	The following data shall be provided: a) the standard vehicle gauge data where referenced, together with identification and justification of all areas where comparison with the comparator vehicle is not exact	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and

	b) confirmation that, where a standard vehicle gauge is used, the vehicle conforms with any underlying assumptions or limitations relevant to that gauge.	does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].
13.1.4	The following data shall be provided: a) the swept envelope data necessary to permit comparison between the vehicle and the comparator vehicle b) the comparator vehicle data where referenced, together with identification and justification of all areas where comparison with the comparator vehicle is not exact c) confirmation that, where a comparator vehicle is used, the characteristics of the vehicle being evaluated conform with the characteristics of that comparator vehicle.	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].
13.2	The train operator shall submit to the infrastructure controller a vehicle gauging portfolio containing the swept envelope data or confirmation of the compliance of the vehicle with the standard vehicle gauge or comparator vehicle, as appropriate to the route(s) for which authority to operate is sought. The submission shall include: a) a vehicle diagram, giving an overview of the vehicle concerned (all vehicles) b) details of any non-compliance referred to in sections B8.4 or B9.3 (only for cases where a comparator vehicle or standard vehicle gauge are use) c) a vehicle profile summary drawing, identifying the location of the body plan view and cross sectional profiles (for absolute gauging only) d) vehicle body plan view profiles (for absolute gauging only) e) vehicle cross sectional profiles (for absolute gauging only) f) swept envelopes for each significant track configuration	The RETB NG antenna is fitted to the forward-most point of the roof on the vehicle centerline of the locomotive such that the top of the antenna is below the maximum height of the vehicle, as shown in Reference Drawing MP-C0-00048 [Reference 16] and does not present any gauging infringement as discussed in MP HAZ ID 005 [Reference 4].

	and location relevant to the route(s) along which the vehicle may be expected to operate (for absolute gauging only). The above items are defined in sections B13.2.1 to B13.2.5 of this document. Each item shall have a unique identification reference number.	

Table J - GM/RT2161 - Requirements for Driving Cabs of Railway Vehicles - Issue 1

Clause	Topic	Response
4.1	The driving cabs of vehicles that operate on Railtrack lines shall be designed and maintained so that they provide safe and efficient working environments in which drivers and other authorised staff can carry out their duties safely and effectively.	Drawings MP-C0-00047 [References 15] shows the modifications have been designed to fit in with the existing cab design. The cab installation design has been subject to review with the operators.
4.2	Driving cabs shall meet the requirements of this standard over the full range of variations in vehicle and track conditions that are likely to be experienced. Account shall be taken of; The influences of cab and vehicle dimensional tolerances, vehicle payload variations, suspension characteristics, normal variations in maintenance condition and wear and cab and vehicle failure modes and conditions. The likely routes of operation and the extent and effects of operation in tunnels. The range of ambient weather, temperature, humidity conditions, daytime and night time conditions and any other relevant variables.	As 4.1
4.3	Cabs shall be maintained so that prescribed tolerances for components, assemblies and systems that influence the mandatory requirements for cab performance are sustained	Maintenance information for the Class 47s to be updated to include new equipment.

	over the lives of the vehicles.	
4.4	The dimensions of cab interiors, including their fixtures, furniture, fittings, equipment, instruments etc shall be appropriate for safely accommodating drivers with a wide range of physical dimensions, as specified in accordance with reference 1.	Drawings MP-C0-00019 and MP-C0-00020 [References 23 and 24] shows that the CDR and the handset can be easily operated by the driver from the normal seated position.
5.1	The driver shall be provided with a driving position from which the train can be safely controlled. A seat provided for the driver shall be readily adjustable to accommodate the drivers with a range of body dimensions as specified in Section 4.4. The driving position may be designed to allow the driver to stand whilst controlling the train.	As 4.4
5.2	From the driving position, the driver shall be able to readily operate all primary controls and easily read all primary instrumentation as defined in Section 7, whilst maintaining the vision requirements of Section 6.1.	The handset and CDR can be easily operated by the driver from the normal seated position.
5.4	A driver shall have easy access to the driving position and be able to vacate it rapidly for operational reasons or for emergency escape.	Drawing MP-C0-00047 [Reference 15] shows the modifications have been designed to fit in with the existing cab design. The cab installation design has been subject to review with the operators.
6.1.1	Seated Drivers. The front windscreen of a cab shall provide, as a minimum, the following clear, unobstructed lines of sight (views) for the driver seated at the driving position, taking into account the variations and tolerances described in Section 4.2. and the requirements of Section 6.2.6. For each viewing case below, a person's eyes shall be considered…. Etc. Case (a)	Drawing MP-C0-00054 [Reference 17] shows that the CDR and the handset do not interfere with the sightline requirements of GM/RT2161.

	Etc Case (d) Etc Note (2) The above viewing cases lead to three usually different viewing points within the reference cube…etc.	
7.1	The driving cab shall incorporate appropriate and reliable controls, instruments and audible and visual warning devices to enable the driver to perform his duties safely and effectively, as defined by the Rule Book and other working instructions, and in accordance with the requirements for train safety systems as prescribed in reference 7.	The installation has been completed in accordance with Interface Control Document ICD-1051-01 [Reference 1]
7.1.1	Controls and instruments should be arranged and operated in a logical and functional manner, to maximise driver effectiveness and to minimise errors.	Drawings MP-C0-00019 and MP-C0-00020 [References 23 and 24] shows that the CDR and the handset can be easily operated by the driver from the normal seated position.
7.1.2	The designs, locations and modes of operation of controls and instruments should, as far as practicable, be consistent with proven best practices or better.	As 7.1.1
7.1.3	Controls and instruments should be clearly marked with unambiguous descriptions, pictograms etc. to indicate their functions.	The installation has been completed in accordance with Interface Control Document ICD-1051-01 [Reference 1]
7.1.4	The operation of controls and the viewing of instruments, should not be unduly fatiguing, or require physical or mental abilities beyond the competence standards prescribed for train drivers in ref 1.	As 7.1.3
7.1.5	Controls and instruments should be appropriately graduated and/or illuminated so that the driver can quickly and accurately detect their operating positions and readings, under all ambient lighting conditions. Where controls and instruments are graduated, the graduations should be sufficiently fine and precise to enable the driver to drive the train accurately and	The installation has been completed in accordance with Interface Control Document ICD-1051-01 [Reference 1]

	within the permitted speed profiles on its permitted routes.	
7.1.6	Illuminated controls and instruments should be so positioned, cowled or dimmed that they do not produce excessive levels of illuminance or produce unwanted reflections off the cab windscreen or off other surfaces that will mislead or distract the driver.	The brackets being installed on the driver's desk are to be finished in a dull matt finish to prevent reflections in the windscreen.
7.1.7	Controls and instruments should be robust and protected against malfunction as far as is reasonably practicable.	The installation has been completed in accordance with Interface Control Document ICD-1051-01 [Reference 1]
7.2.1	The following primary controls and instruments, where required and fitted as essential for the safe driving of the train or vehicle, shall be operable and/or viewable by the driver whilst at the main driving position. Direction and movement control Etc Other controls and instruments which, because of their safety functions, must be operated or viewed whilst the driver is controlling the train.	The location of the equipment does not impede the use of the primary controls on the vehicle.
7.2.2	Wherever practicable, the visual field directly in front of the driver, when in the driving position, should be reserved for the siting of primary controls and instruments vital to the continuing safe operation of the train. Etc. Account should be taken of the amount of driver's head and eye movements needed, with the objective of maximising the driver's visual concentration on track and signals.	The installation of the RETB equipment does not change the visual field directly in front of the driver. There are no changes to the siting of the existing primary controls and instruments.
7.4	Audible and visual warnings inside the cab shall be distinctive and have appropriate loudness and sound qualities and/or light intensities, according to their functions, urgency and importance. They shall not distract the driver's attention unnecessarily from his normal driving duties.	As 7.1.3.

8.1	The driver and other staff, where appropriate, shall be able to gain safe access to and safe egress from the driving cab, under both normal and emergency conditions, in accordance with reference 9	Drawing MP-C0-00047 [Reference 15] shows the modifications have been designed to fit in with the existing cab design. The cab installation design has been subject to review with the operators.
9.1	The driver and others shall be provided with a safe and efficient working environment in terms of; The ergonomic layout of furniture, fittings, controls, instruments and general ambience. Air quality, temperatures and lighting levels, in accordance with reference 10. Ride quality, noise and vibration levels and aerodynamic pressure pulses in accordance with reference 8.	Drawing MP-C0-00047 [Reference 15] shows the modifications have been designed to fit in with the existing cab design. The cab installation design has been subject to review with the operators.

Table K - GM/RT2304 - Equipotential Bonding of Rail Vehicles to Running Rail Potential - Issue 3

Clause	Topic	Response
B.4.1	Bond impedance	Drawing MP-C0-00058 [Reference 21] shows that the RETB equipment is bonded to the vehicle body via cables RNGE01. Drawings MP-C0-00048 [Reference 16] shows that the antenna is bonded to the vehicle via a connection to the steel structure of the cab.
B.4.2	Bonding provision	See above
B.4.3	Bonding connection capacity	See above
B.4.4	Bonding connection design	Designed to best practice using components already used on rail vehicles.
B.4.5	Bonding conductors and terminations	Designed to best practice. Bonds are easily accessible.

B.4.6	Bonding continuity	Class 47 RETB Installation Modification And Test Procedure [Reference 5] details a bonding test to confirm that the RETB equipment is bonded to the vehicle.
B.4.7	Traction return current circuits	N/A
B.4.8	Current in bearings and mechanical components	N/A
B.5.1	Rail vehicles fitted with shoe gear	N/A
B.5.2	Rail vehicles fitted with pantographs and other roof mounted equipment	N/A
B.6.1	Bonding system inspection	Maintenance information for each operators is to be updated to include new equipment.
B.6.2	Bonding system maintenance	Maintenance information for each operators is to be updated to include new equipment.