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Issue: One
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Guidance on the Application of the Control of Electromagnetic Fields at Work Regulations

Synopsis

This document gives guidance on the application of the Control of Electromagnetic Fields at Work Regulations in the railway environment, and supplements the processes set out in the Health and Safety Executive's guidance on the regulations.

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Issue Record

Issue	Date	Comments
One	June 2016	Original document Provides guidance on the application of the Control of Electromagnetic Fields at Work Regulations in the railway industry.

Superseded Documents

This Rail Industry Guidance Note does not supersede any other Railway Group documents.

Supply

The authoritative version of this document is available at www.rssb.co.uk/railway-group-standards. Enquiries on this document can be forwarded to enquirydesk@rssb.co.uk.

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Part 1 Introduction

1.1 Purpose

1.1.1 This document gives guidance on the application of the Control of Electromagnetic Fields at Work Regulations 2016 (CEMFAW Regulations) in the railway environment. This document does not set out requirements. The Health and Safety Executive's (HSE) guidance sets out the general processes for complying with the requirements of the CEMFAW Regulations.

1.2 Structure of this document

1.2.1 Guidance is provided as a series of sequentially numbered clauses.

1.3 Approval and Authorisation

1.3.1 The content of this document was approved by a Multifunctional Standards Committee on 18th April 2016.

1.3.2 This document was authorised by RSSB on 1st June 2016.

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Part 2 Summary of Guidance

2.1 General

2.1.1 As part of managing health and safety, employers need to control the risks in the workplace under the Management of Health and Safety at Work Regulations 1999, consider what might cause harm to people and take reasonable steps to prevent harm – this includes considering any risks arising from exposure to Electromagnetic Field(s) (EMF(s)). The CEMFAW Regulations require assessment and recording of employees' potential exposure to EMF(s) with reference to Action Level(s) (AL(s)) and Exposure Limit Values (ELVs).

2.1.2 This industry guidance indicates that, for the majority of work locations within the railway, the CEMFAW Regulations low AL(s) are not exceeded, and the high AL(s) and ELVs are never exceeded. This aligns with the earlier work set out in the RSSB research reports T515 and T1051.

2.1.3 Workers at particular risk (see [3.6 Workers at particular risk](#) on page 13), such as pregnant workers and workers with implanted medical devices, will always require further consideration. They should be identified by means of staff records or a medical questionnaire and additional assessments undertaken for the effects of EMF(s) in relation to their particular condition. The assessment process for the effects of EMF(s) on implantable medical devices is set out in BS EN 50527-1:2010.

2.2 Record keeping

2.2.1 Most employers in the railway industry will need to keep a suitable record of the significant findings from the most recent exposure assessment, the most recent action plan, and the most recent risk assessment. A review of the exposure assessment will be required if circumstances change.

2.3 AC electrification

2.3.1 For AC fields, only a very small proportion of workers will be exposed to fields in excess of the low AL(s) under normal conditions. Situations for which additional risk assessments are required are:

- a) Workers working within 100 mm of a cabled Autotransformer Feeder ATF.
- b) Workers working within 150 mm of an insulated return conductor.
- c) Workers working within 125 mm of an aerial earth wire.
- d) Workers working within 125 mm of a Red Bond at feeding sites or an across track Black Bond.
- e) Workers working within 600 mm of 25 kV uninsulated conductors and return conductors (normally prohibited by electrical safety rules).
- f) Workers working within 230 mm of an insulated three-phase high-voltage cable.
- g) Workers at particular risk (see [3.6 Workers at particular risk](#) on page 13).

2.4 DC electrification

2.4.1 For DC fields this study has found that risks are generally low, but situations for which additional risk assessments are required are:

- a) Workers working within 230 mm of an insulated three-phase high-voltage AC power cable.
- b) Workers at particular risk (see [3.6 Workers at particular risk](#) on page 13).

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2.5 Rolling stock and rail mounted plant

2.5.1 For AC fields, only a very small proportion of workers will be exposed to fields in excess of the low AL under normal conditions. Situations for which additional risk assessments are required are:

- a) Workers working within 0.3 m of radiating train mounted radio frequency (RF) transmitters.
- b) Workers working within 1 m of a radiating Eurobalise reader.
- c) Workers working within close proximity of main traction and train heating supply cables.
- d) Workers at particular risk (see [3.6 Workers at particular risk](#) on page 13).

2.5.2 For DC fields this study has found that risks are generally low, further assessment is only required for workers at particular risk (see [3.6 Workers at particular risk](#) on page 13).

2.6 Signalling and communication equipment

2.6.1 For AC fields, only a very small proportion of workers will be exposed to fields in excess of the low AL under normal conditions. Situations for which additional risk assessments are required are:

- a) Workers working within 1 m of a radiating Eurobalise reader.
- b) Workers working within 0.3 m of radiating lineside or train mounted radio frequency (RF) transmitters. For workers working at height close to high-power RF transmitters, the manufacturer's and operator's procedures and instructions regarding separation from an antenna should be followed.
- c) Equipment rooms where the equipment is not compliant with the EMC Directives and Regulations.
- d) Workers at particular risk (see [3.6 Workers at particular risk](#) on page 13).

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Part 3 Guidance on the Application of the Electromagnetic Field Directive to Railways

3.1 Scope

3.1.1 This industry guidance note has been prepared to provide a simple methodology for employers in the railway environment to understand what they need to do to comply with the CEMFAW Regulations. The CEMFAW Regulations are the enactment of the Electromagnetic Field (EMF) Directive (2013/35/EU) within the UK.

3.1.2 This industry guidance note is intended to be read alongside the HSE publication 'A guide to the Control of Electromagnetic Fields at Work Regulations 2016' (HSG 281). (See list of reference documents). This industry guidance note has been based upon draft HSE guidance made available in April 2016.

3.1.3 All electrical and electronic devices give rise to EMFs of varying levels. In the vast majority of cases the fields are very small and decay rapidly with increasing distance.

3.1.4 This industry guidance note is written specifically for the railway industry to identify workers at risk from exposure to EMFs in the railway environment and hence comply with the requirements of the CEMFAW Regulations. This includes, but is not limited to, maintenance, operational and support workers working on stations, lineside, in equipment rooms and on rolling stock. This industry guidance note was produced with input and knowledge from across the railway industry, including Network Rail (NR), London Underground (LU), Freight and Train Operating Companies (FOCs / TOCs) and rolling stock leasing companies (ROSCOs) and the Office of Rail and Road (ORR).

3.1.5 This industry guidance note will support the rail industry approach to managing worker safety. Once the risks have been assessed, employers may need to brief workers, advise them of areas of potential risk and the mitigations necessary, and consider if there are any employees that are at particular risk. Throughout the remainder of this document the term 'worker' is used for the person exposed to EMFs.

3.1.6 The industry guidance in this document is based upon modelling, measurements and qualitative assessments performed in and around railway infrastructure and rolling stock. All values for the modelling are, as far as practical, the worst case levels for current and voltage under normal operating conditions, which will only be present in a small number of instances across the railway as a whole. The HSE guide to the CEMFAW Regulations is silent on transient events, such as the rare and short duration faults on electrification systems (see [3.4.7](#) on page 12 to [3.4.8](#) on page 12).

3.1.7 The Electricity at Work Regulations require that 'every work activity, including operation, use and maintenance of a system and work near a system, shall be carried out in such a manner as not to give rise, so far as is reasonably practicable, to danger'. The railway adopts the control methods of isolation, earthing, or electrical clearance to fulfil this requirement. In many cases, these control measures also control the exposure to EMFs.

3.1.8 The diagrams shown throughout this document use colour solely to differentiate the parts of the system.

3.2 Introduction to the regulations

3.2.1 In 2004, the European Commission published the Physical Agents (Electromagnetic Fields) Directive (2004/40/EC) to address the minimum health and safety requirements regarding exposure of workers to the risks arising from EMFs. This Directive was never transposed into UK law through a statutory instrument or publication of an identical national standard.

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3.2.2 The 2004 Directive was repealed by the European Commission on 26 June 2013 by the publication of Directive 2013/35/EU dealing with the same subject matter. This decision was taken after serious concerns were expressed by industry stakeholders with regards to the impact of some of the provisions of the 2004 Directive on certain industrial activities. The commission examined the arguments put forward by stakeholders against new scientific information produced by internationally recognised experts. It was concluded that the 2004 Directive should be repealed and more appropriate and proportionate measures to protect workers from the risks associated with EMFs should be introduced.

3.2.3 Directive 2013/35/EU, as enacted in the UK by the CEMFAW Regulations, is intended to address all known direct biophysical effects and indirect effects caused by EMFs. The objective is not only to ensure the health and safety of each worker, but also to create a minimum basis of protection for all workers in the European Union (EU).

3.3 Other sources of guidance

3.3.1 The CEMFAW Regulations require that an employer carries out and records a suitable and sufficient assessment of the potential exposure of employees to EMFs. In carrying out the assessment, employers may take into account:

- a) Emission information and other safety related data provided by the manufacturer or distributor of equipment used by the employer.
- b) Industry standards and guidelines.
- c) The EU practical guide - EU non-binding guide to good practice for implementing Directive 2013/35/EU Electromagnetic Fields. (See list of reference documents.)
- d) Guidance produced by the Health and Safety Executive (HSE) – ‘A guide to the Control of Electromagnetic Fields at Work Regulations 2016’ – which includes links to many other sources of information. (See list of reference documents.)
- e) Hazard directories and risk registers maintained by the owner and operator of equipment.

3.4 Limitations

3.4.1 This document provides information on a number of common scenarios that exist on the mainline railway. It does not address the following areas, although they are within the scope of the CEMFAW Regulations.

3.4.2 Those items out of scope of the Great Britain (GB) mainline railway are as follows:

- a) Tram systems. However, consideration is given to areas where NR or LU workers may need to access infrastructure that is in close proximity to tram systems.
- b) The infrastructure and vehicles operating on historic or tourist electric railways.
- c) The infrastructure and vehicles operating on high-speed railways, HS1 (St Pancras to the Channel Tunnel), the Channel Tunnel and the proposed HS2.

3.4.3 The following are out of scope as they require individual assessment to quantify the risk:

- a) Specialised plant, machinery and testing equipment in depots and factories.
- b) ‘Yellow Plant’ and other specialised rail vehicles.
- c) Investigative techniques that may generate high fields, for example ultrasonic testing and magnetic crack detection.
- d) Welding. Guidance and a software based assessment tool have been published by TWI (The Welding Institute) - Research Report 1018 – Electromagnetic Fields (EMF) in the welding environment - Prepared by TWI Ltd for the Health and Safety Executive. (See list of reference documents).

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- e) Power conditioning equipment such as harmonic dampers, harmonic filters and static VAR Compensators.
- f) Other infrastructure which influence the railway such as power lines crossing the railway. Some information on these is set out in the HSE guidance. (See list of reference documents.)

3.4.4 In instances where the electrification configurations implemented are novel, or not covered in this industry guidance note, a specific designer's risk assessment covering EMF is performed for these particular schemes and suitable guidance provided within the health and safety file and hazard directories for the electrification project. An example of a novel design is the 'independent feeder cables' proposed for installation in current electrification schemes.

3.4.5 Operators of the systems or equipment set out above, are referred to the CEMFAW Regulations prepared by the HSE, and the EU non-binding guide to good practice for implementing Directive 2013/35/EU.

3.4.6 The CEMFAW Regulations provide no limits for transient conditions such as faults and inrush currents. These are sharp increases in the current drawn when an electrical fault occurs on the network or when, for example, a transformer is energised, respectively. The electrification system is provided with protection systems that are designed to limit the fault duration to a few cycles of the 50 Hz AC waveform. Switching transients and inrush currents are similarly limited in duration by the design of the system. For over-exposure to occur, a worker would have to be present close to the path of the transient, when this infrequent and short duration event occurs. Transient exposures are therefore extremely unlikely to constitute over-exposure that would cause significant biological effects.

3.4.7 Faults are unplanned and unpredictable events. It is not possible to predict where or when a fault may occur, nor how close an employee may be at the time of the transient (which may also be caused by switching events) current flow. Employers only need to take steps to assess reasonably foreseeable risks. Without knowing where workers will be in relation to the circuits at the time of the fault and the fault current flowing, a meaningful assessment is not possible. Circuit protection will terminate the fault condition within a few milliseconds (~5-10 ms). Even though the interaction with an employee will be virtually instantaneous, the consequences of the exposure arising from these extremely rare events are unlikely to cause harm. This view is supported by reference to the work of IEEE in C95.6 (2002), which uses a time averaging period for exposures to low frequency EMFs of 200 milliseconds.

Note: Information provided by the ORR. A CENELEC drafting group is considering including reference to this in a standard that is likely to be published in the near future.

3.4.8 During the deliberate creation of transient conditions, for example during testing or fault location, precautions are required to ensure that worker exposure remains below the exposure limits defined in the CEMFAW Regulations.

3.5 Exposure levels for the general public and third party workers

3.5.1 The CEMFAW Regulations apply only to workers, and place duties only on their employers. They do not apply to the general public.

3.5.2 The responsibility for the assessment of exposure to EMFs for the employees of third parties, such as contractors, working on railway infrastructure, premises or railway vehicles, lies with their employer. The owner or operator of the premises or railway vehicle will provide any information necessary to support this risk assessment.

3.5.3 Assessment of exposure to EMFs for the general public visiting the railway infrastructure or travelling within railway vehicles is undertaken by the transport operator in accordance with the HSE guidance. For the general public, there are a different set of non-mandatory public limits that are more onerous than the workforce limits defined in the CEMFAW Regulations. These are set out in Council Recommendation

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1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz). (See list of reference documents.)

3.6 Workers at particular risk

3.6.1 General

3.6.1.1 Specific consideration should be given to the safety of workers at particular risk, such as pregnant workers or workers with active implanted medical devices (AIMDs), passive implanted medical devices (PIMDs) and body worn medical devices (BWMDs) where they have informed their employer of their condition or devices, even if exposure is below the exposure limits.

3.6.1.2 The HSE guidance gives more information with regard to the assessment of workers at particular risk, and lists examples of the types of implanted medical devices to be considered in the assessments. (See list of reference documents.)

3.6.1.3 With respect to passive implantable medical devices, these are specifically mentioned within the CEMFAW Regulations and the HSE guidance. It is however understood that, with respect to passive devices, the threat is predominantly related to attraction risks in the presence of high field-strength sources. Table AL6 of the CEMFAW Regulations defines high field-strength sources as having a field strength in excess of 100 mT. In the railway there are no sources that are designed to generate field strengths of this magnitude; therefore, the risk to passive devices is considered negligible and hence no further assessment is required.

3.6.1.4 Where it is known workers have implantable medical devices fitted, a specific assessment will need to be undertaken to quantify the risk. A medical questionnaire should be completed to identify the risks to these workers, in accordance with the requirements of BS EN 50527-1. The employer can only assess the risks to workers who have notified them that they have devices fitted.

3.6.1.5 Employers may need to ensure that their workers' records are up-to-date with regard to this type of device and will need to consider the sensitivity of workers in their dealings with workers in relation to the personal nature of some of these devices.

3.6.2 Pregnant workers

3.6.2.1 As working with certain levels of EMFs could result in a greater risk to a pregnant worker, workers should be encouraged to advise their employer in writing if they become pregnant. A practical approach is to limit the exposure of pregnant workers to the public exposure limits; these are set out in Council Recommendation 1999/519/EC. (See list of reference documents.)

3.7 Action levels

3.7.1 The CEMFAW Regulations prescribe ALs and exposure limit values (ELVs) for both electric and magnetic fields across a range of frequencies. The ELVs have been established from scientifically well-established short-term and acute direct effects from EMFs. These ELVs are established for both sensory and health effects, which are described as follows:

- a) Sensory effects: disturb sensory perceptions and brain functions.
- b) Health effects: thermal heating or stimulation of nerve and muscle tissue.

3.7.2 The ELVs are specified in terms of internal body quantities that cannot be directly measured or simply calculated and thus would require complex modelling of how fields interact with the different parts of the body. As a result, the Directive prescribes ALs in terms of external field quantities that can be directly measured or calculated. The ALs simplify the process of demonstrating compliance with the ELVs and are split into 'low ALs' and 'high ALs' as follows:

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- a) Electric fields: low ALs and high ALs relate to specific protection or prevention measures set out in the CEMFAW Regulations.
- b) Magnetic fields: low ALs relate to the sensory effects ELVs, and high ALs relate to the health effects ELVs.

3.8 Exemptions

3.8.1 The CEMFAW Regulations make provisions for the HSE to set out certain activities that will be exempt from the exposure limits set out in the regulations. Any exemption will be time limited for a period of no more than five years, and can be revoked or amended by the HSE at any time. If a work activity is exempt it will not be necessary to comply with the exposure limits in respect of that activity, but the following exemption conditions must be met:

- a) Reducing the exposure to the lowest level reasonably practicable, noting that these will still be above the ELV; and
- b) Ensuring that workers are protected against the health effects and safety risks posed by that exposure.

3.8.2 If an activity is exempted, the use of measurements or calculations in assessment of exposure is not required, because these are only required where it is necessary to demonstrate compliance with the exposure limits, not if the work activity is exempted. Details of the exempted activities and the process for requesting an additional exemption are set out on the HSE website (see list of reference documents). There will be very few activities undertaken in the railway industry which will fulfil the criteria for an exemption.

3.9 Action levels applied in this guidance

3.9.1 The occupational exposure action level values applied in this guidance note are set out in Table 1 [Worker exposure action levels](#) on page 14

	Magnetic field action level	Electric field action level
AC 50Hz	Low AL 1 mT High AL 6 mT	Low AL 10 kV/m High AL 20 kV/m
DC	400 mT (see 3.9.3 on page 14)	Not applicable
Radio transmitters	Not applicable	61 V/m

Table 1: Worker exposure action levels

3.9.2 With the exception of workers fitted with implantable medical devices, which is outside the scope of this industry guidance note, no specific ALs are provided for DC magnetic fields within the EMF Directive. In the absence of a suitable limit for biological effects in the CEMFAW Regulations, the values provided by the 2009 International Commission on Non-Ionising Radiation Protection (ICNIRP) document have been used as a guide, based on the recommendation of paragraph (15) of the EMF directive. (See list of reference documents).

3.9.3 The occupational levels for exposure to magnetic fields of 2 T for occupational exposure of head and trunk and 8 T for occupational exposure of limbs, referenced within the ICNIRP guidelines on limits of exposure to static magnetic fields, are more applicable to hospital environments, such as magnetic resonance imaging (MRI) rooms, so the more conservative recommended value for the general public of 400 mT for exposure of any part of the body is adopted in this industry guidance note.

3.9.4 Whilst harmonics of 50 Hz exist throughout the railway, the levels of these current and voltage harmonics are insignificant with respect to the fundamental frequency. Thus if the fields generated at 50

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Hz are compliant with the ALs in the CEMFAW Regulations, the fields generated at the harmonics will also be compliant.

3.9.5 The CEMFAW Regulations set out a table of limits for radio frequency electric fields. The most stringent limit prescribed is 61 V/m for the 10-400 MHz frequency range and thus, if the electric field across the remaining frequencies complies with this limit, it will automatically be compliant with the specific limit for that particular frequency.

3.10 Identification of potential hazards

3.10.1 The principal hazards, with respect to human exposure to EMF, are magnetic fields which are due to current flowing in conductors and electric fields caused by potential difference between conductors.

3.10.2 Although electrical equipment itself gives rise to EMFs, with the exception of large transformers such as those found at substations, it has been found that the levels generated are below those published in the CEMFAW Regulations, due to the inherent protection of the metallic housing.

3.10.3 While all electrical conductors generate magnetic and electric fields, only conductors carrying high levels of current or operating at high voltages (HVs) give rise to fields which need to be considered by this assessment process.

3.10.4 Conductors carrying high levels of current or voltage include:

- a) Those associated with the traction power system, for example autotransformer feeder (ATF) and the overhead contact line.
- b) Conductors connected to transformers and switchgear in substations.
- c) Cables used for shore supplies in depots.
- d) Conductors connected to non-traction transformers and switchgear in substations located in stations and maintenance depots.

3.10.5 On rail vehicles, conductors connecting the pantograph to the transformer and feeds running from the transformer to other high-voltage equipment such as the motor inverters, auxiliary converters, AC/DC line converters and battery chargers will require consideration. On DC and dual voltage vehicles, conductors running from the shoe gear will require consideration.

3.10.6 Vehicles with motor generator or alternator sets may also generate significant fields in and around the connecting cabling.

3.10.7 As a general rule the largest magnetic fields are generated when the vehicle is in motion; however, fields generated by the battery charger and auxiliary converter will be present all of the time the vehicle systems are switched on.

3.10.8 High levels of electric fields can be generated by antennas used for radio communications, including Eurobalise readers.

3.11 EMF assessment process

3.11.1 An assessment process has been developed using flowcharts to identify case studies which require further assessment. Further assessment may mean either additional modelling or measurements. The assessment may identify additional control methods which need to be implemented in order to limit exposure to EMFs.

3.11.2 An assessment will be required for workers at particular risk, as set out in [3.6 Workers at particular risk](#) on page 13. Employers may wish to perform a review of those workers using an occupational health questionnaire to identify those activities which require further assessment.

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3.12 How to perform an EMF Assessment

3.12.1 The CEMFAW Regulations require that a risk assessment is undertaken for all workers to establish their exposure to EMFs and the results recorded. The level of detail required in this assessment will vary with the environment in which the work takes place. The HSE guidance will enable most 'low risk' environments to be covered in a simple assessment.

3.12.2 The railway is generally a high risk environment and so may require a more detailed assessment. To facilitate this assessment, a series of scenarios have been evaluated, the results of which form the basis of this industry guidance note. Reference to the contents is set out in Table 2 [Scenarios modelled](#) on page 16 and [Appendix A Report on EMF Modelling](#) on page 51. These case studies are referenced against the decision in the flow charts as shown in Figure 1 [Example flowchart decision which arises from case study 16](#) on page 16. The results of the modelling are set out in full in a report supporting this industry guidance note "Report on the Application of the Control of Electromagnetic Fields at Work Regulations 2016".

3.12.3 It is possible for the HSE to issue an exemption for certain activities known to exceed the exposure limits (assessed against the ALs).

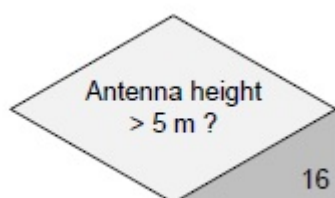


Figure 1: Example flowchart decision which arises from case study 16

Does your workplace have any of the following?	Description	Worker Location	Case Study Number (Reference to the supporting report see Appendix A Report on EMF Modelling on page 51)
Workers at particular risk	A further assessment will always be required - the HSE guidance sets out more information about the assessment of workers at particular risk		Not assessed
AC Electrified Classic Rail Return System (4.2 25 kV AC 'classic' rail return system without booster transformers on page 20)	25 kV AC OLE System Classic Rail Return	Lineside	Case study 7
AC Electrified Booster Transformer System(4.3 25 kV AC 'classic' rail return system with booster	25 kV AC OLE System Booster Transformer	Lineside	Case study 6

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Does your workplace have any of the following?	Description	Worker Location	Case Study Number (Reference to the supporting report see Appendix A Report on EMF Modelling on page 51)
transformers on page 22)			
AC Electrified Autotransformer System(4.4.2 ATF in a platform with workers on platform on page 25)	25 kV AC OLE ATF System cable located in a platform	On Platform	Case study 1
	25 kV AC OLE ATF System conductor mounted on a high level structure	Lineside	Case study2
	25 kV AC OLE ATF System cable mounted on posts plus traction feeder cable	Lineside	Case study 3
	25 kV AC OLE ATF System conductor mounted on a high level structure	On over bridge	Case study 4 a) Steel over bridge b) Wooden over bridge
	25 kV AC OLE AT System Bus-bars	Inside substation	Case study 5
DC Electrified System (Part 5 DC Electrification on page 33)	750 V DC Third Rail System	Lineside	Case study 8
	630V DC Fourth Rail System	Lineside	Case study 9
	750 V DC Third Rail Substation	Inside substation	Case study 10
	750 V DC Depot Shore Supply	Lineside	Case study 11
	25 kV AC OLE and 750 V DC Third Rail Interfaces	Lineside	Case study 12
Interfaces (Railways and Substations) (Part 6 Interfaces and Lineside Conductors on page 36)	Tram and Light Rail Interfaces	Lineside	Case study 13
	Traction Supply Transformers	Inside substation	Case study 14
	Trackside HV Cables (Unbalanced)	Lineside	Case study 15
Lineside Radio Systems and Equipment / Control Rooms or Offices (EMF	Lineside Radio Transmitters	Lineside	Case study 16

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Does your workplace have any of the following?	Description	Worker Location	Case Study Number (Reference to the supporting report see Appendix A Report on EMF Modelling on page 51)
guidance for lineside radio systems and equipment / control rooms or offices)	Equipment Rooms	Inside equipment room	Case study 17
Rolling Stock (Part 8 Rolling Stock on page 42)	25 kV AC / 750 V DC EMU - Dynamic	Lineside	Case study 18
	25 kV AC / 750 V DC EMU - Static	Lineside	Case study 19
	25 kV AC / 750 V DC EMU	Inside Vehicle	Case study 20 a) Static: Worker inside cab b) Static: maintenance worker inside vehicle
	25 kV AC / 750 V DC EMU Driving Cab	Inside Vehicle	Case study 21
	750 V DC EMU - Dynamic	Lineside	Case study 22
	Diesel Electric Locomotive Driving Cab	Inside Vehicle	Case study 23
	Diesel Electric Locomotive: Dynamic:	Inside Vehicle	Case study 24
	Rolling stock - Roof Mounted RF Antennas	Inside Vehicle	Case study 25
	Rolling stock - Underframe and Bodyside Mounted RF Antennas	Trackside	Case study 26
	Rolling stock - High Speed Train	Inside Vehicle	Case study 27
	Rolling stock - Mark III and Mark IV Coaching Stock	Inside Vehicle	Case study 28

Table 2: Scenarios modelled