

Research Brief



Investigation into the effect of the Physical Agents (Electromagnetic Fields) Directive on railway operations

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Background

By April 2008, the European Directive 2004/40/EC (subsequently referred to as "the Directive") on Physical Agents (Electromagnetic Fields) was to be transposed into UK regulations. Now a draft directive is anticipated in 2010, so transposition has subsequently been delayed until at least 2012.

The Directive requires that employers protect their employees from exposure to hazardous Electromagnetic Fields (EMFs).

The Directive is applicable to the rail industry (as well as other industries) and therefore all railway employers must comply with its requirements.

Whilst employers already have an obligation to protect employees from hazardous EMFs under the provisions of the Health and Safety at Work Act 1974, the Directive requires compliance with defined limits for all frequencies from DC to 300GHz.

The Directive defines acceptable levels of exposure using two terms; Action Level and Exposure Limit.



Figure 1: Radio Frequency emission measurements of a Class 390 Pendolino to EN50121:3-1:2000

An Action Level is a measurable value, which if not exceeded ensures compliance with the requirements of the Directive. The

Action Level is derived from the Exposure Limit, and includes a safety factor.

An Exposure Limit is an absolute level that is not to be exceeded. It represents the underlying effects that EMFs have on the human body and is specified in terms of current density or absorbed power. It is difficult to measure current density in the human body and/or the power that is absorbed because of an EMF. Consequently, assessments against the Exposure Limit criteria are difficult.

CENELEC has now published EN 50500 and EN50499 that are designed to support compliance with the Directive.

Aims

The aim of the research was to investigate the effects of the Directive on railway operations by:

- Reviewing the extent to which the railway industry might be affected by EMFs.
- Identifying control measures that might be necessary to comply with Directive 2004/40/EC.

The Directive does not cover the effects of EMFs on the general public, so the research therefore focussed on the risk presented to railway workers. However, it did review the risks presented to the general public and risks to people with pacemakers and other implanted medical devices.

Method

The research into the effects of the Directive on railway operations has involved the following activities:

- A review of the background to EMFs, the requirements of Directive 2004/40/EC and published EMF limits.
- Identification of the types of EMF that could be encountered on the railway and the groups of people at risk.
- Identification of the circumstances that could result in exposure to excessive EMFs.
- Calculation and measurement of EMFs present in the railway environment.
- A review of the EMFs against the limits defined in the Directive.
- In the absence of a EuroNorm applicable to railway applications, a review of assessment methods.
- Identification of possible mitigation and management methods.

- In the case of the 25kV electrified railway, identification of the distance from an overhead line at which the EMF limits could be exceeded.

The research has involved a nine-month programme of work, with the following key stages:

- In a stakeholder workshop, identification of those EMF sources that are likely to present the greatest threat in conjunction with a review of exposure circumstances.
- Assessment of worst case system configurations using computer based tools.
- Site tests.
- Completion of research, including assessment of mitigation measures.

The systems that have been evaluated as part of the research project include:

- AC electrification equipment (e.g. 25kV catenary, traction return conductor, traction return rail, traction bonds, 25kV feeder cables, autotransformer feeder cables, mid-point connections).
- DC electrification equipment (e.g. conductor rail, return rail, feeder and return cables).
- Radio frequency (RF) sources (e.g. VHF, UHF, GSM-R handheld and base station transmitters and receivers).
- Other sources/systems (such as Automatic Warning System (AWS) and Automatic Power Control (APC) magnets, traction cables on rolling stock, TPWS transmitters, RF transmitters on rolling stock, Eurobalises).

A combination of modelling, calculation and testing has been used to assess the configurations of these systems that have the greatest potential to exceed the Directive's electric and magnetic field limits.

Findings

In the railway context there is little to differentiate circumstances in which occupational or public exposure takes place.

The research found that the employee groups likely to have the highest levels of exposure are:

- Maintenance staff, and in particular those who in the performance of their duties may come into close proximity to high voltage/current equipment limited only by the requirements for a safe system of work under the Electricity at Work Regulations 1989.

- Telecommunication engineers who work on transmission equipment (e.g. antennas).

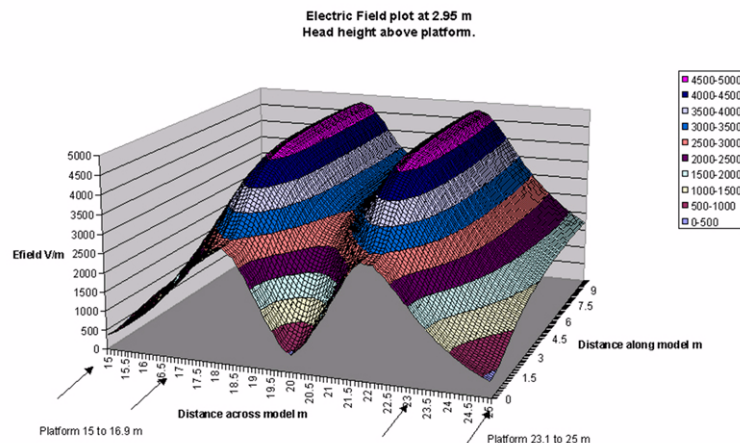


Figure 2: Field at head height on a platform for an OCS voltage of 25kV

The research found:

- 25kV electrification system: Most of the scenarios analysed appeared to be compatible with published limits.
- DC electrification system: The 750V DC system is not capable of exceeding the occupational electric or magnetic field Action Levels.
- For most railway RF sources, it is unlikely that the occupational Action Levels would be exceeded, except for those maintaining transmitters or those who come in close proximity for other reasons.
- The EMFs produced by a variety of other sources/systems have been evaluated (e.g. AWS/APC magnets, TPWS loops, etc.). From this preliminary work, the EMFs produced by these systems are generally compatible with the occupational Action Levels.
- Hazards associated with pacemakers and other medical implantable devices are not covered by the requirements of the Directive in terms of limits. However, the Directive does require that the hazards are considered within a risk assessment regime.

Possible methods for mitigating and/or managing exposure to excessive EMFs have been identified and reviewed. The potential controls include:

- Engineering controls (e.g. increased shielding).
- Administrative controls (e.g. setting up safe working distances).
- Training (a measure that complements the two controls identified immediately above).

In conclusion the railway would appear to be broadly compatible with the requirements of the Directive.

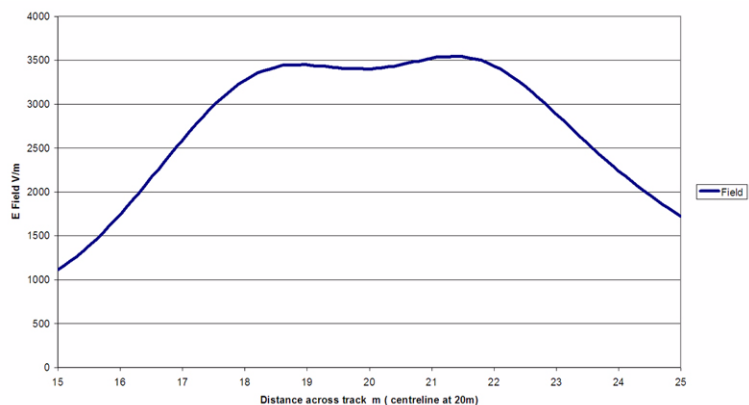


Figure 3: Field at head height for a person crossing a two-track line for an Overhead Contact System voltage of 25kV

Next Steps

During the course of this project the transposition of the European Directive 2004/40/EC on Physical Agents (Electromagnetic Fields) has been delayed until (at least) 2012, whilst a number of practical and technical issues are resolved with the Directive. RSSB will await the outcome of the European Commission deliberations, and publication of the revised Directive (draft anticipated in 2010) and then seek industry guidance on the need to undertake further work to support industry compliance with the UK regulations and implementing the revised Directive.

RSSB Technical Experts will continue to monitor progress and will advise rail industry stakeholders of significant developments.

Contact

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