



eastwest
interconnector

ELECTRIC AND MAGNETIC FIELDS (EMF) FACTS AND THE EAST WEST INTERCONNECTOR

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INTRODUCTION

EirGrid regards the protection of the health, safety and welfare of its staff and the general public as a core company value. It is EirGrid's policy to design and operate the transmission network to the highest safety standards and to comply with the most up-to-date international guidelines and recommendations.

A debate about the possible health effects of electric and magnetic fields (EMF) associated with electric power systems on humans and animals has continued over the last number of decades. Despite extensive worldwide research, international review bodies have found no conclusive evidence that exposure to EMF encountered in normal living and working conditions are harmful to public health. EirGrid continues to review new developments and research findings and is satisfied from the totality of studies and the views of authoritative bodies that the balance of evidence is that EMF emissions from electric power systems do not cause adverse effects on health.

People have questions and require clear and well-supported answers. This booklet was designed to provide those answers, and give specific information in relation to static magnetic fields and the East West Interconnector. We are committed to addressing your concerns in an open manner and to this end are providing this fact sheet on EMFs associated with the East West Interconnector.

JOHN FITZGERALD,

East West Interconnector Project Director, EirGrid

The magnetic fields from the East West Interconnector are similar to the earth's magnetic fields.

WHAT IS A FIELD?

A field describes the influence of an object on its surrounding space. For example, a temperature field may exist around a hot object. EMFs can occur naturally within nature. The earth is itself an immense natural magnet with magnetic poles near the north and south poles.

WHAT IS AN ELECTRIC FIELD?

An electric field is produced within the surrounding area when voltage is applied to a conductor (or wire). Just as the area (i.e. walls) around a hot-water pipe is affected by the temperature of the pipe, the area surrounding an electrical conductor is influenced by the conductor voltage. The strength of an electric field at a given location depends on two factors — the level of voltage applied to the conductor and the distance from it.

There are no external electric fields associated with the East West Interconnector's underground DC cables.

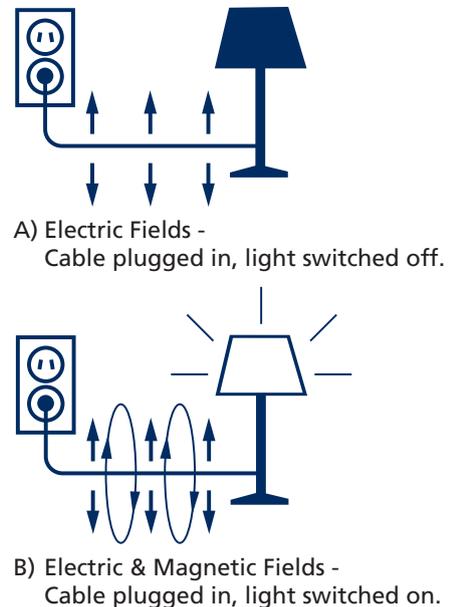
This is because the DC (or static) electric field produced is contained within the cable.

WHAT IS A MAGNETIC FIELD?

Magnetic fields are produced where electric current is present, i.e. when electricity is flowing through the conductor (or wire). The strength of a magnetic field at a given location depends on the level of current flowing in the conductor or wire and the distance from it. Magnetic fields are normally expressed in terms of a quantity called the magnetic flux density, expressed in terms of tesla (T). This relatively large unit is often expressed in submultiples such as microtesla (μT – one millionth T). For example the earth's magnetic field varies between $30\mu\text{T}$ and $60\mu\text{T}$.

The magnetic fields from the proposed East West Interconnector are referred to as a static field, i.e. the High Voltage Direct Current cable does not have a frequency like the 50Hz transmission system in Ireland.

FIGURE 1



EMFS & THE EAST WEST INTERCONNECTOR

Electricity is a natural phenomenon. It occurs as lightning and within the human body as electric fields and currents which allow information to flow within cells and tissues. Apart from these natural phenomena, EMF is produced wherever electric power is in use.

In Ireland, electricity varies at a power frequency of 50Hz (i.e. alternating back and forth 50 times each second) and produces Electric and Magnetic Fields (EMF). At home and at work, similar fields are produced by wiring and by electrical appliances in everyday use. The earth produces EMFs, mainly in the form of static fields. It is the flow of current in a cable that creates a magnetic field around that cable. Since the current in East West Interconnector is constant, and does not vary, the magnetic field around the cable also is constant, like the earth's natural occurring magnetic fields.

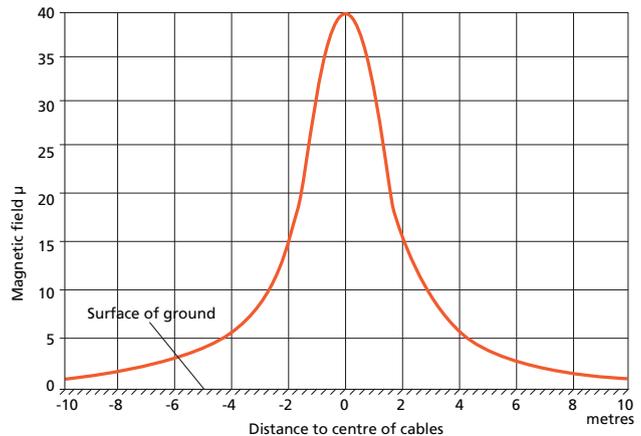
The EMFs associated with the proposed East West Interconnector are generally referred to as static or Direct Current fields and have no frequency i.e. 0 Hertz. They have similar characteristics to the EMF that occur naturally in the Earth, e.g. Earth's own magnetic field or during lightning storms.

Naturally occurring magnetic fields, such as that of the Earth, are relatively weak. The earth's magnetic field varies between 30uT at the equator and 60uT at the poles.

The East West Interconnector cable will be buried to a depth of approximately one metre, the strongest magnetic field strength will be on the ground directly above it and will be typically the same as the Earth's natural field. Figure 2 below illustrates that the field strength will decrease rapidly as you move away from the cable centre line – this is similar to the decreasing heat effect as you move away from a candle.

FIGURE 2

Magnetic field 1 metre above surface of ground. Two Direct Current cables installed 0.5 metre apart.



Typical magnetic field profile with distance from DC cable

The above is typical of the cable technology under consideration for the East West Interconnector.

STANDARDS & GUIDELINES

INVESTIGATIONS OF STATIC EMF EFFECTS

There has been research into possible health effects from power system EMF and this section attempts to summarise the issues. Independent and authoritative international and national review panels of scientific experts have reviewed studies on possible health effects and have concluded that EMF in normal living and working conditions do not cause adverse health effects in humans. None of the authoritative bodies responsible for the development of the international recommendations on EMF exposure considered it necessary or appropriate to limit the construction of electricity infrastructure. Having reviewed the authoritative opinions, EirGrid will continue its policy of adhering to the international and national standards and guidelines with which the entire network complies.

INTERACTION MECHANISMS

High-frequency electromagnetic waves have a short wavelength and high energy; low-frequency waves have a long wavelength and low energy. There is no evidence that the zero or low frequency, low energy waves associated with DC power systems have any adverse health effects in humans.

A very strong magnetic field is required to stimulate nerve and muscle. The World Health Organisation (WHO), stated that acute effects are only likely to occur at 2T, i.e. 2,000,000 μ T. When comparing this level with the magnetic field strength associated with the DC cables i.e. no greater than 60 μ T, it can be seen there is no possibility of the proposed DC cables causing induced currents.

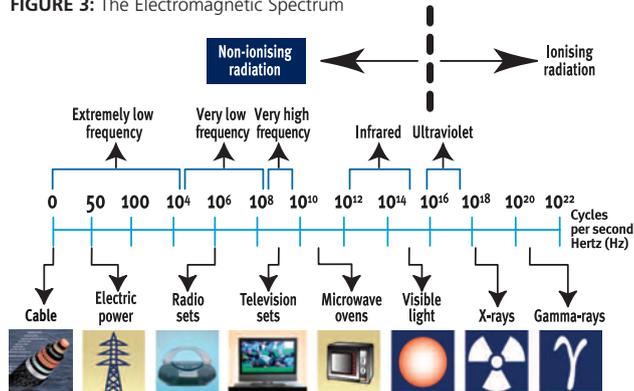
THE DIFFERENT SOURCES OF EMF

FIELDS WITHIN THE ELECTROMAGNETIC SPECTRUM (RANGE)

There are many different sources of EMF and radiation (energy in the form of electromagnetic waves). The sun heats the earth using electromagnetic radiation, vision is possible because of electromagnetic radiation, watching television and listening to radio are pastimes made possible by modern telecommunications and the ingenious use of electromagnetic fields. Not all these fields are the same, they are distinguished by their frequency which is measured in cycles per second or Hertz (Hz) (See Figure 3, the Electromagnetic Spectrum).

Direct Current (as will be used in the East West Interconnector) cables have no frequency i.e. 0 Hertz and are therefore at the very start of the electromagnetic spectrum. At the extremely low frequency (ELF) end of the electromagnetic spectrum we find EMF typical of those associated with power lines, in Ireland power line frequency is 50 Hertz.

FIGURE 3: The Electromagnetic Spectrum



Moving up the spectrum we pass through radio, TV and microwave frequencies into visible light. Further up, in the ultraviolet region of the frequency spectrum, electromagnetic radiation becomes 'ionising radiation'.

Ultraviolet light, X-rays and gamma rays are ionising radiation and have sufficient energy to break apart the molecules which make up genes. Excessive exposure to these forms of radiation is dangerous.

EMFs are produced in everyday situations by electrical wiring and electrical appliances. In many cases domestic electrical appliances and tools can generate much higher EMF levels in their close proximity than a DC underground cable. The fields from HVDC cables tend to be constant over time while the magnetic fields produced by appliances only arise when they are in use.

There are also static magnetic fields generated from DART and LUAS suburban transportation systems, MRI units and in a number of industrial processes including aluminium manufacture and gas welding. Figure 4 above illustrates static magnetic field levels from Electric Trains and MRI units compared to static magnetic field levels from a DC underground cable.

The HVDC cable magnetic field profile on the previous page illustrates maximum DC cable field levels.

FIGURE 4: Comparisons of static magnetic field levels



RESEARCH INTO POTENTIAL HEALTH EFFECTS

EirGrid operates the existing electricity transmission system in full compliance with the international full EU Guidelines.

There is no evidence that the zero or low frequency low energy waves associated with Direct Current power cables like the East West Interconnector have any adverse health effects in humans.

International Commission on Non-Ionising Radiation Protection (ICNIRP)

In 1998, ICNIRP issued guidelines for EMF exposure for members of the public. These guidelines formed the basis of those adopted by the EU in 1999. EirGrid's proposed East West Interconnector will fully comply with ICNIRP and EU guidelines for EMF exposure.

Since it is not possible to measure induced current density in the human body ICNIRP set a reference level that could be easily measured and built in an additional safety factor. They recommended that members of the public should not be exposed to DC magnetic fields that exceed $40,000\mu\text{T}$. The magnetic field strength associated with the proposed DC cables will not exceed $60\mu\text{T}$.

Department of Communications, Marine and Natural Resources (DCMNR) Report, March 2007

In March 2007, the DCMNR published a report entitled Health Effects of Electromagnetic Fields, compiled by an international expert group. The DCMNR report states that 'neither static magnetic nor static electric fields, at the levels members of the public are normally exposed to in the environment,

are a short-term or a long-term health hazard' and recommended continued compliance with the international guidelines on EMF exposure.

World Health Organisation (WHO)

The WHO in its 2006 report, Static Electric and Magnetic Fields (WHO, 2006), stated that acute effects are only likely to occur at 2T, i.e. $2,000,000\mu\text{T}$. The recommended maximum magnetic field exposure levels in the international guidelines are well below this and the levels from a HVDC underground cable are considerably below this level. A subsequent study carried out by the WHO EMF Task Group concluded in 2007 that there are no substantive health issues related to EMF at levels generally encountered by members of the public.

International Agency for Research on Cancer (IARC)

In 2001, IARC, which is an agency of the WHO, stated that 'there is inadequate evidence in humans for the carcinogenicity of static electric or magnetic fields and extremely low-frequency electric fields.' They also stated that there is no relevant data available from experimental animals regarding carcinogenicity.

EirGrid operates the existing electricity transmission infrastructure in full compliance with ICNIRP and EU guidelines. The East West Interconnector will be designed such that even under the most adverse operating conditions the strongest magnetic field (i.e. standing directly above the cable centre line) will never exceed the ICNIRP guidelines.

EirGrid hopes that this booklet has been informative and that it provides a greater understanding of DC (static) magnetic fields.

- There are no external electric fields associated with the East West Interconnector.
- The magnetic field around the East West Interconnector cable is constant like the earth's natural occurring magnetic fields.
- The magnetic field strength decreases rapidly as you move away from the cable centre line.
- EMFs are produced in everyday situations by electrical wiring and appliances.
- Independent and authoritative international review panels of experts conclude that EMF in normal life and working conditions do not cause adverse health effects in humans.

GLOSSARY

AC (ALTERNATING CURRENT) – Electrical circuits where the voltage and current alternate direction, in Ireland at 50 times per second 50 Hertz (Hz).

CARCINOGENIC – Causing cancer.

CURRENT – The movement of an electrical charge analogous to the rate of fluid flow in a pipeline.

DC (DIRECT CURRENT) – Electrical circuits with no operating frequency, i.e. 0Hz.

ELECTRIC FIELDS – Invisible fields of force where voltage is present.

ELECTRICITY – A form of energy created by the flow of current or the presence of voltage

ELF (EXTREMELY LOW FREQUENCY) – Frequencies found at the end of the electromagnetic spectrum that contain very little energy and cannot directly break molecules apart, i.e. non-ionising. 50Hz Electric power operates at ELF levels.

FREQUENCY – The number of repetitions per unit time of a complete waveform.

INDUCED CURRENT – Current which flows in a body as a result of an interaction with an electric or magnetic field.

IONISING RADIATION – Radiation, such as X-rays, which has sufficient energy to break molecular chemical and electrical bonds.

MAGNETIC FIELDS – Invisible fields of force found where electric current is present.

MOLECULE – The smallest particle of a substance that retains the properties of that substance.

RADIATION – Any of a variety of forms of energy propagated through space.

VOLTAGE – The measure of potential strength of electricity. Voltage in a power line is analogous to pressure on a pipeline.