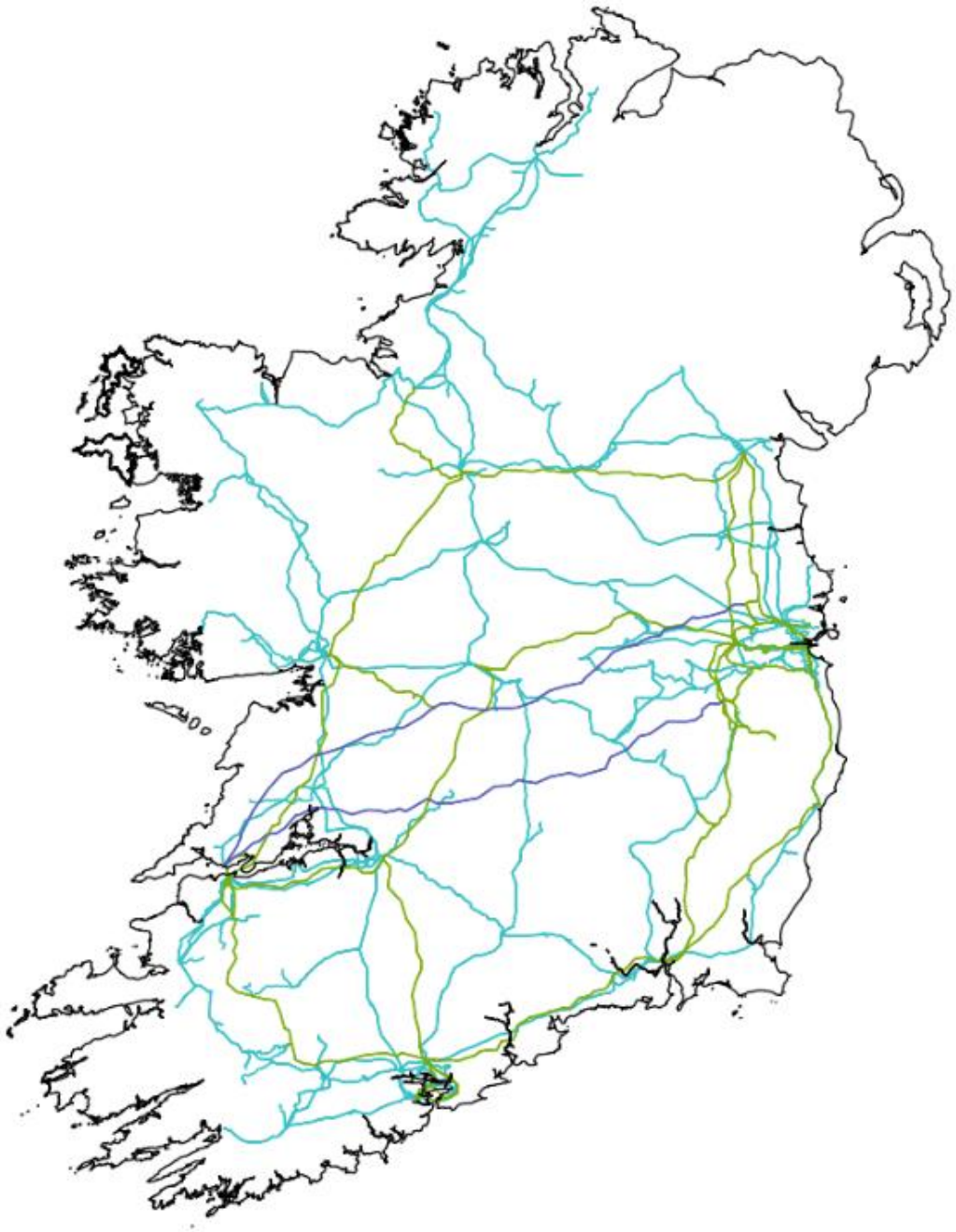
Results of Static and Extremely-Low-Frequency Electric and Magnetic Fields Monitoring Programme 2023-2024

September 2026

Environmental Protection Agency (EPA)



High-voltage transmission network in Ireland. Dark blue lines (400 kV), green lines (220 kV), light blue lines (110 kV). Source: EPA, based on data provided by ESBN (March 2023).

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Executive Summary

The EPA has responsibility for the provision of advice to the public and the Minister for Climate, Energy and the Environment (DCEE) on public exposure to non-ionising radiation (NIR) in the frequency range 0 Hz to 300 GHz. This part of the electromagnetic spectrum is commonly referred to as electromagnetic fields (EMF). To support the development of advice, the EPA monitors EMF exposure in public spaces.

In 2023/2024, the EPA conducted EMF measurements associated with major electricity infrastructure, such as high-voltage powerlines. There are two types of EMF emitted from major electricity infrastructure, they are Extremely Low Frequency (ELF) electric and magnetic fields (ELF-EMF) from AC current and static electric and magnetic fields from DC current. The programme focused on measuring static magnetic fields and ELF-EMF at locations where people live or work within 50 metres of major electricity infrastructure, including 110 kV, 220 kV, 275 kV and 400 kV overhead lines, underground cables and substations. In total, 52 locations were measured across the country.

The results for static and ELF magnetic fields were all well below recommended levels, known as Reference Levels. ELF electric field results for the substations and underground cables were all well below the Reference Level of 5,000 V/m.

Results for ELF electric fields from overhead powerlines at 110, 220 and 275 kV were all below the Reference Level of 5,000 V/m. ELF electric fields from 400 kV overhead powerlines were measured at eleven locations throughout the country, the results at nine of these locations were below the Reference Level of 5,000 V/m. The Reference Level for ELF electric fields was exceeded at two locations but not at a level that would have any health effects. The EPA repeated monitoring at these locations and the measurement results for ELF electric fields were below the Reference Level. This may be due to differences in the amount of electrical current being carried and/or environmental conditions at the time the measurements were conducted. The EPA is continuing to monitor the ELF-EMF levels at these locations.

Based on the results from the monitoring programme, no adverse health effects are expected from EMF associated with electricity infrastructure in Ireland. The EPA will continue to monitor EMF exposure to further inform the provision of advice. Results of ongoing and future monitoring will be published on the EPA website when they become available.

1. Introduction

The Radiological Protection Act 1991 (Non-Ionising Radiation) Order 2019[1] extended the functions of the EPA to cover public exposure to Non-Ionising Radiation (NIR) in the range 0 Hertz (Hz) to 300 Giga Hertz (GHz). This part of the NIR spectrum includes electric and magnetic fields, commonly referred to as electromagnetic fields or EMF. Depending on the frequency of EMF, measured in Hertz (Hz) (Figure 1), the term EMF may refer to:

- Static electric and magnetic fields (0 Hz),
- Extremely Low Frequency (ELF) electric and magnetic fields (>0 Hz – 3 kHz) or
- Radiofrequency (RF) electromagnetic fields (>3 kHz – 300 GHz).

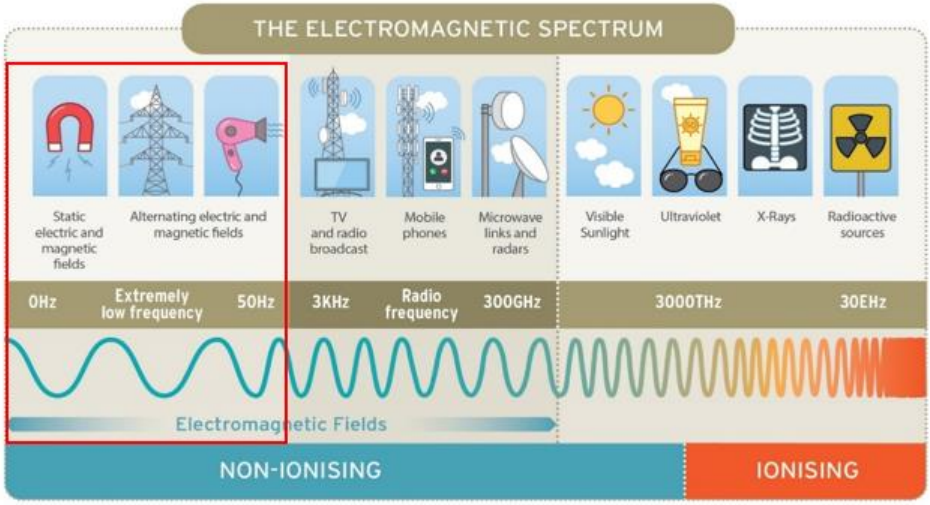

Figure 1. The electromagnetic spectrum – highlighting the static and ELF EMF - frequency spectrum.

The 2019 Order places the responsibility on the EPA to:

- provide advice to the Minister for Climate, Energy and the Environment (Minister) on public exposure to electromagnetic fields, including advice on regulations and standards regarding public exposure;
- provide general information to other Ministers, local authorities and members of the public on public exposure to electromagnetic fields;
- monitor and keep the Government and Minister informed of the implications for the State of scientific, technological, economic developments pertaining to public exposure to electromagnetic fields;
- cooperate with the relevant authorities in other States on public exposure to electromagnetic fields;
- represent the State on international bodies as directed by the Minister.

The EPA do not regulate sources of EMF exposure, such as electricity infrastructure, mobile phone masts or other infrastructure emitting EMF.

[1] S.I. 190 of 2019 https://www.irishstatutebook.ie/eli/2019/si/190/made/en/print

To enable the EPA to provide advice, the Order provides for the EPA to independently monitor public exposure to EMF. In August 2023, the EPA updated its EMF monitoring programme to include measurement of EMF associated with major electricity infrastructure, in particular the high-voltage transmission network (Figure 2).

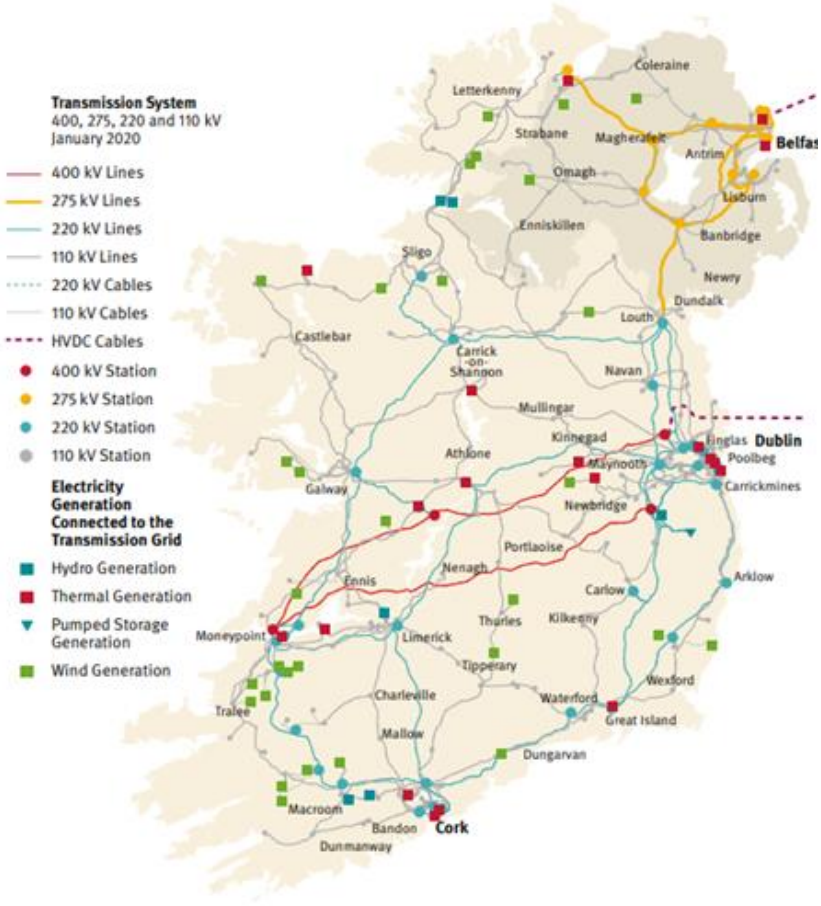

Figure 2. Map of the electricity transmission network in Ireland. Source: Adapted from EirGrid website[2].

2. Characteristics of EMF associated with electrical infrastructure

The type of EMF associated with electrical infrastructure are called static and Extremely Low Frequency (ELF) electric and magnetic fields.

Electrical infrastructure such as power lines, cables and other equipment and appliances emit static and/or Extremely Low Frequency (ELF) electric and magnetic fields (EMF) depending on whether they carry direct current (DC) or alternating current (AC) electricity. Static fields and ELF EMF do not propagate far from the emitting sources. For example, the levels of EMF measured at around 100 m from a high-voltage overhead powerline[3] are close to zero (background).

[2] https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Group-Transmission-Map-March-2021.pdf
[3] EirGrid 2014. EMF Study. https://cms.eirgrid.ie/sites/default/files/publications/EirGrid-Evidence-Based-Environmental-Study-1-EMF.pdf

3. Static EMF

Electrical infrastructure carrying direct current (DC) electricity such as DC underground cables emit static electric and magnetic fields. They have a frequency of 0 Hz. Static electric fields (also known as electrostatic fields) are created by charges that are fixed in space or moving at constant velocity. The best known and most powerful display of static electric fields occurs in nature as lightning. Static magnetic fields are created by magnets or charges that move at a steady flow, such as in direct current (DC) electricity. The Reference Level for public exposure to static magnetic fields is 40 milli-Tesla (mT). There is no specific Reference Level for public exposure to static electric fields[4].

4. Extremely Low Frequency EMF

Extremely Low Frequency (ELF) electric and magnetic fields (EMF) are produced whenever alternating current (AC) electricity is generated (power stations), transmitted and distributed (power lines and cables) or used (electrical appliances). ELF EMF have frequencies between 1 Hz and 3 kHz. The frequency used for electricity transmission in Ireland and other European countries is 50 Hz. ELF electric and magnetic fields have independent characteristics and need to be measured separately. ELF electric fields are easily blocked by solid materials, including buildings, trees and the ground. ELF magnetic fields are not easily shielded. However, both electric and magnetic fields fall off rapidly with distance from the source.

5. Electricity infrastructure in Ireland

The Commission for Regulation of Utilities (CRU) is responsible for regulating the electricity networks and licencing of the electricity transmission and distribution operators. CRU has granted two system operator licenses; these are held by:

- EirGrid, the electricity transmission system operator.
- ESB Networks, the electricity distribution system operator.

Table 1 gives an overview of the electricity transmission network in Ireland. EirGrid is responsible for operating and planning the development of the transmission system. The high-voltage electricity transmission network in Ireland comprises overhead and underground power lines and cables using three main voltages (110 kV, 220 kV and 400 kV), as well as other infrastructure including substations and generation centres. A single overhead line using 275 kV extends for a few kilometres between Ireland (Louth) and Northen Ireland (Tandragee)[5]. This 275 kV 'tie line' is used as the method for synchronising the Northern Ireland and Ireland power systems together. This is the only part of the Irish transmission network that operates at a voltage other than 110 kV, 220 kV and 400 kV (Table 1 and Figure 2).

[4] Council Recommendation 1999 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999H0519
[5] https://cms.eirgrid.ie/sites/default/files/publications/All-Island-Transmission-System-Performance-Report-2024.pdf

ESB Networks is responsible for the operation, maintenance and development of the electricity distribution system. This is a lower voltage system (less than 110 kV) which supplies power directly to homes and businesses around the country. ESB Networks is also responsible for designing and developing the transmission network[6]. EirGrid and ESB Networks are required to develop, operate, and maintain a safe and secure electricity system[7] while having due regard for health and the environment. Following best practice, EirGrid and ESB Networks voluntarily abide by international recommendations with regard to EMF emitted by the transmission, and the distribution networks, respectively[8].

6. AC & DC underground cables

At the time of the monitoring work, there was only one interconnector in active operation in Ireland (East-West Interconnector), which includes a 400 kV underground DC cable between Rush (Co. Dublin) and an AC/DC convertor station located near Portan, Co. Meath. DC electricity is received here from Wales via the 400-kV undersea cable. The public can be exposed to static magnetic fields from the 400 kV underground (DC) cable (see Section 9) while exposure to static electric fields from this cable is unlikely as these are mostly blocked by the ground. There are around 3 km of 400 kV AC underground cables in the country which are associated with convertor and generation centres. They are not accessible by the public and cannot lead to public exposure to EMF.

Table 1. Electricity transmission infrastructure in Ireland.

Electricity Infrastructure	Infrastructure Length	Infrastructure Quantity
400 kV overhead lines	438 km	2 lines
400 kV (AC) underground cables	3 km	4 cables
400 kV (DC) underground cables	30 km	1 cable
400 kV substations	--	5 substations
220 kV overhead lines	1802 km	52 lines
220 kV underground cables	205 km	47 cables
220 kV substations	--	41 substations
110 kV overhead lines	4755 km	242 lines
110 kV underground cables	589 km	185 cables
110 kV substations	--	216 substations
275 kV overhead lines	21 km	2 lines
275 kV underground cables	0.2 km	1 cable
275 kV substations	--	1 substation

Note: Information obtained from ESB Networks (March 2023).

[6] https://www.gov.ie/en/department-of-climate-energy-and-the-environment/policy-information/electricity/
[7] Electricity Regulation Act 1999. https://www.irishstatutebook.ie/eli/1999/act/23/enacted/en/html
[8] ESB 2017. EMF and You. https://esbnetworksprdsastd01.blob.core.windows.net/media/docs/default-source/publications/esb-networks-electrical-and-magnetic-fields-.pdf?sfvrsn=43304888_0

7. International and EU guidelines for static and ELF EMF

In 1998, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) issued guidelines containing recommended exposure levels, known as Reference Levels, for EMF between 0 Hz and 300 GHz[9]. The 1998 ICNIRP guidelines for the public were adopted in Europe through a European Council Recommendation in 1999[10]. The international guidelines and Council Recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) seek to prevent potential health effects or biological effects such as micro shocks and phosphenes[11] due to an induced current in the body of more than 2 milli Amps per square metre (mA/m^2). Since the induced current levels inside the body cannot be easily measured, it is the external field conditions that give rise to the induced current levels that are measured. The two external field parameters of interest in the vicinity of electrical infrastructure are:

- the electric field, measured in volts per metre (V/m); and
- the magnetic field, measured in micro-Tesla (μT).

For ELF (50 Hz) fields, the Council Recommendation 1999 contains a Reference Level of 5,000 V/m for the electric field and 100 μT for the magnetic field (Table 2). In addition, the Recommendation includes a Reference Level of 40 mT for static magnetic fields (0 Hz). No reference level is included in the Council Recommendation for static electric fields (0 Hz).

Table 2. Summary of EU Reference Levels for (50 Hz) ELF-EMF.

	Electric Field (V/m)	**Magnetic field (μT)**
Council Recommendation 1999	5,000	100

8. EPA's static and ELF EMF monitoring programme

Our monitoring programme focused on static magnetic fields and ELF EMF emitted by the high voltage electricity transmission network (Figure 2), as this infrastructure can give rise to the highest exposure levels based on previous research commissioned by the EPA[12].

The objective of this monitoring programme is to assess public exposure to static magnetic fields and ELF-EMF from major electricity infrastructure in Ireland, including 110 kV, 220 kV, 275 kV and 400 kV overhead powerlines, underground cables and substations. The focus was to measure exposure in those locations where members of the public are likely to be most exposed and to compare these results to the Reference Levels set out in the Council Recommendation 1999. Following recommendations from

[9] ICNIRP Guidelines 1998 https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
[10] Council Recommendation 1999 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999H0519
[11] Phosphenes are defined by ICNIRP as "the perception of faint flickering light in the periphery of the visual field" (https://www.icnirp.org/cms/upload/publications/ICNIRPFactSheetLF.pdf)
[12] Electromagnetic Fields in the Irish Context, RIVM 2015. https://www.rivm.nl/bibliotheek/rapporten/2015-0073.pdf

previous research on ELF EMF commissioned in Ireland[13][14], the selection of locations, including rural and urban settings, was informed by the following criteria, whereby the highest exposures to the public:

- Tend to come from overhead powerlines.
- Usually come from equipment at the highest voltages.
- Tend to occur within about 50 m of overhead lines.
- May occur while passing under overhead lines.

Available information on the grid was used to identify locations of interest within 50 m of existing major electricity infrastructure. First, potential measurement locations were identified based on the proximity of electrical infrastructure to dwellings or other buildings. Second, potential locations within 50 m of the infrastructure of interest were assessed and a subset of these locations (n=52) was selected based on density of buildings, public access and accessibility for safely carrying out the measurements.

Surveys were carried out within 50 m of accessible major electricity infrastructure, including 110 kV, 220 kV, 275 kV and 400 kV overhead powerlines, underground cables and substations. Some types of infrastructure, including some 400 kV (AC) and 275 kV underground cables and substations, were not measured as they are not publicly accessible and are unlikely to lead to public exposure to EMF.

Surveys included electric and magnetic field measurements using portable equipment as well as ancillary measurements such as temperature and humidity, survey location and coordinates, distance between the measurement point(s) and the type of electrical infrastructure, and height of the lowest overhead powerline, where appropriate (see Appendix for further information on the measurement methodology). Figure 3 shows a typical measurement location. Table 3 shows the total number of locations measured by infrastructure type.

[13] Electromagnetic fields from high voltage transmission lines. Government of Ireland. Department of Energy, McManus, T. 1988 https://www.lenus.ie/handle/10147/575273
[14] Health Effects of Electromagnetic Fields, DCMNR 2007 https://www.epa.ie/publications/monitoring--assessment/radiation/DCMNR-2007---Health-effects-of-electromagnetic-fields.pdf

Figure 3. Typical survey location in a rural area showing the measurement point nearby a dwelling within 50 m of a high-voltage overhead powerline.

Table 3. Measured locations by electricity infrastructure.

Electricity Infrastructure	400 kV	220 kV	275 kV	110 kV	Total
Overhead lines	11	12	1	8	**32**
Underground cables (AC)	0	4	0	4	**8**
Underground cables (DC)*	1	--	--	--	**1**
Substations	3	3	0	5	**11**
Total	**15**	**19**	**1**	**17**	**52**

*Note: Only one 400 kV DC underground cable in use in Ireland at the time.

In total, 52 locations within 50m of existing transmission infrastructure were surveyed. At locations near overhead power lines, one or more sets of measurements were conducted depending on accessibility, i.e. right under the line known as centreline and/or nearby (i.e. within 50m) the electrical infrastructure. In total, 79 measurements were obtained at the 52 selected locations.

9. Summary of Results

Below is a summary of the results obtained. Individual results can be found in the Appendix to this report.

9.1 Static magnetic fields

Static (0 Hz) magnetic field results near the 400 kV (DC) underground cable near Portan, Co Meath were well below the corresponding Reference Level of 40 milli-Tesla (mT) (Table 4).

Table 4. Static magnetic fields from East-West interconnector DC underground cable.

Survey Location	Survey Point	Static magnetic field measured level (mT)	Static magnetic field Reference Level (mT)
Portan, Co. Meath	Above the cable	0.11	40

9.2 ELF magnetic fields

No monitored values exceeded 7 μT (i.e. 7% of the 100 μT EU Reference Level) across all of the measurements made at all 52 locations.

9.3 ELF electric fields

All results for 110kV, 220kV and 400kV substations (11 in total) were below 1,000 V/m which is a fifth of EU Reference Level (5,000 V/m). These results tended to be lowest at monitoring locations near 400kV substations as these substations have security fencing at a significant distance from the equipment resulting in monitoring occurring at a distance from the infrastructure but still within 50 m.

ELF electric fields were measured within 50 m of nine alternating current (AC) 110 and 220 kV underground cables. The ELF electric fields measured for all AC underground cables were below 100 V/m, which is approximately 2% of the Reference Level (5,000 V/m).

At selected locations near 110 kV, 220 kV, 275 kV and 400 kV overhead powerlines, measurements were obtained both right under the overhead powerlines (known as “centreline”) and in proximity of nearby buildings. At locations where access to both the centreline and nearby buildings was not possible only one set of measurements were made, either at the centreline or in proximity of nearby buildings. Measurement results for 110 kV, 220 kV and 275 kV (Table 5) lines were all below the EU Reference Level of 5,000 V/m (see Appendix for details).

Table 5. ELF EMF results for the 275 kV overhead powerline.

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Channonrock	Louth	Centreline	1,390	3.3

With respect to the 400 kV overhead powerlines, the majority of the eleven locations measured nearby this infrastructure had electric field levels below the Reference Level of 5,000 V/m. At two locations, measurements above the Reference Level were

obtained within 50m of a 400 kV overhead powerline at Tinnacross, County Offaly (7,890 V/m) and at the centreline at Carrow, County Tipperary (5,248 V/m) (see Appendix). The EPA repeated monitoring at these locations and the measurement results for ELF electric fields were below the Reference Level of 5,000 V/m.

A year-long measurement programme has been put in place to determine the variation of the ELF-EMF levels, environmental conditions (e.g. temperature and humidity) and other factors that can affect the ELF-EMF levels at these two locations. This new monitoring programme will also assist in gaining an understanding of the long-term variability of electric fields from 400 kV overhead powerlines in Ireland.

10. Discussion and Conclusion

During 2023 and 2024, the EPA carried out static magnetic field and ELF electric and magnetic field measurements at 52 locations nearby high-voltage infrastructure throughout the country. The results for static magnetic fields and ELF magnetic fields were all below EU Reference Levels. Most of the results for ELF electric fields were below the corresponding EU Reference Level of 5,000 V/m. Measured ELF electric field levels at two locations within 50m of a 400 kV overhead powerline were above this level. The EPA repeated monitoring at these locations and the measurement results for ELF electric fields were below the Reference Level (see Table A3 in the Appendix for more details).

The electric field Reference Level of 5,000 V/m was exceeded on two occasions during this monitoring programme, with electric field strengths of 7,890 V/m and 5,248 V/m in the vicinity of 400 kV overhead powerlines. These levels are similar to those previously measured[15] and modelled[16] for 400 kV lines by EirGrid.

The European Council issued a Recommendation in 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)[17]. The recommended exposure levels in the Council Recommendation are based on the guidelines issued by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)[18]. Both the ICNIRP Guidelines and the Council Recommendation include recommended internal exposure levels, known as Basic Restrictions, to avoid biological or health effects from exposure to high levels of static and ELF EMF due to an induced current in the body of more than 2 milli Amps per square metre (mA/m^2)[19]. Because an induced current is difficult to measure inside the body, Reference Levels are used as they are easy to measure, and their compliance ensures compliance with the Basic Restriction. It is important to note that the Council Recommendation also states that "*If the measured value exceeds the reference level, it does not necessarily follow that the basic restriction*

[15] EirGrid 2014 monitoring study. https://cms.eirgrid.ie/sites/default/files/publications/EirGrid-Evidence-Based-Environmental-Study-1-EMF.pdf
[16] EirGrid website on EMF. https://www.eirgrid.ie/EMF
[17] EU 1999 Recommendation https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999H0519
[18] ICNIRP 1998 Guidelines https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
[19] Phosphenes are defined by ICNIRP as "the perception of faint flickering light in the periphery of the visual field" https://www.icnirp.org/cms/upload/publications/ICNIRPFactSheetLF.pdf

will be exceeded". Instead, the Council Recommendation suggests that an assessment be conducted to determine whether the exposure level is below the Basic Restriction of 2 mA/m^2. Following the publication of the EU Recommendation in 1999, studies conducted on ELF electric and magnetic fields induced in anatomically realistic models of the human body have demonstrated that to exceed the Basic Restriction of 2 mA/m^2 the electric field strength would need to be greater than 9,200 V/m[20].

Based on this previous research, electric field levels exceeding the Reference Level of 5,000 V/m but below 9,200 V/m do not exceed the Basic Restriction of 2 mA/m^2. Electric fields below 9,200 V/m are, therefore, not considered to cause any adverse effects to the general public. In addition, Reference Levels for the public are also 5 times below the internal field level at which effects are possible (10 mA/m^2)[21]. Moreover, electric fields are easily blocked by solid materials, including buildings and trees. Therefore, the levels of ELF electric fields at which the public may be exposed indoors are significantly lower and are not a concern.

In conclusion, based on the results from this monitoring programme, no adverse health effects are expected from EMF emitted by electricity infrastructure in Ireland. The EPA is continuing to monitor EMF levels to further inform its advice on this topic. The results of this monitoring will be published on the EPA website when they become available.

[20] Peter Dimbylow 2005 *Phys. Med. Biol.* **50** 1047-70. https://pubmed.ncbi.nlm.nih.gov/15798308/
[21] EU 1999 Recommendation https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999H0519

11. Appendix: Measurement methodology and detailed results

ELF electric and magnetic fields are not proportional to each other and need to be measured separately. Spot measurement equipment was used for ELF electric and magnetic fields and static magnetic fields at selected locations. Static electric fields were not measured as there is currently no Reference Level for these fields and no commercially available equipment. Ancillary EMF-related and environmental measurements were also recorded, including temperature and humidity, survey geolocation, and, when possible, height of the lowest overhead conductor and distance between centreline and measurement point(s). For ELF electric and magnetic fields, a Narda NBM-550[22] survey meter and a Narda probe EHP-50F[23] were used, which allow measurement of electric and magnetic fields in the range between 1 Hz and 400 kHz. Static magnetic fields were measured using the same Narda NBM-550 survey meter and a Narda HP-01 probe, which allows measurement in the frequency range between 0 Hz and 1 kHz.

EMF measurements were carried out following the recommendations in the Standards IEC 62110 and IEC 62233. For this purpose, a non-metallic tripod was used to hold the Narda probes (EHP-50F and HP-01) at approximately 1 metre from the ground. To the extent possible, the probe was kept between 1.5m and 3m away from nearby objects (such as vegetation, fences etc), including the operators, by using a fibre-optic cable between the meter (Narda NBM-550) and the probe being used. Records were kept including date, time, person making the measurements, and the instruments used. Photographs of the survey sites and points were also taken. The temperature and relative humidity at the time of each set of measurements, along with a general statement of the weather conditions, were recorded. For measurements near overhead lines, where possible, measurements were obtained at the centreline and at various distances from the centreline, including nearby dwellings and other buildings within 50m of the centreline. For measurements near substations, surveys were carried out at approximately 1-3 m outside the perimeter fence or outer wall. For measurements near underground cables, the location of the cable was identified from maps as best as possible, also checking for any indications on the ground (trenches, manhole covers, cabinets). Where possible, measurements were carried out right over the cable and at several distances from it.

[22] https://www.narda-sts.com/en/wideband-emf/nbm-550/

[23] https://www.narda-sts.com/en/selective-emf/ehp-50f-field-strength-analyzer/

Results of the individual EMF field measurements.

Table A 1. ELF electric and magnetic fields measured nearby 110 kV overhead powerlines.

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Guideline Values			**5000**	**100**
Kilnamanagh	Dublin	Centreline	1969	1.7
		Within 50m	116	0.2
Scotsman Road, Monkstown	Cork	Centreline	567	1.7
		Within 50m	297	1.4
Terry's Land, Cork City	Cork	Centreline	126	0.8
Oakdrive	Cork	Centreline	531	1.7
		Within 50m	1059	1.6
		Within 50m	440	0.6
Kiltipper Rd, Dublin city	Dublin	Centreline	735	2.0
		Within 50m	1276	1.6
		Within 50m	389	1.0
An Sean Bhaile	Galway	Centreline	632	0.4
		Within 50m	673	0.2
Carrowmore	Mayo	Centreline	79	0.6
		Within 50m	330	0.3
Drumbar	Donegal	Centreline	13	0.04
		Within 50m	6	0.04
Ballyclare	Roscommon	Centreline	79	1.2
		Within 50m	210	0.7

Table A 2. ELF electric and magnetic fields measured nearby 220 kV overhead powerlines.

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Guideline Values			**5000**	**100**
Coolgreany, Gorey	Wexford	Centreline	462	0.6
		Within 50m	704	0.5
Ballyadam	Cork	Centreline	790	0.5
Ballykeeroge, Campile	Wexford	Within 50m	422	0.5
Stryker-Anngrove	Cork	Within 50m	618	0.3
Laurel Hill, Monkstown	Cork	Centreline	23	0.3
Oakdrive	Cork	Centreline	2093	0.6
		Within 50m	1888	0.9
		Within 50m	1227	0.2
Deerpark Place	Dublin City	Centreline	817	2.4
		Within 50m	525	1.5
Hollywood Road	Dublin	Centreline	3340	6.7
Newtown	Meath	Within 50m	149	1.4

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Guideline Values			**5000**	**100**
Tallanstown	Louth	Centreline	171	0.6
		Within 50m	322	0.2
Lacka East	Kerry	Centreline	192	1.3
Knocklong West	Limerick	Within 50m	1	0.2

Table A 3. ELF electric and magnetic fields measured nearby 400 kV overhead powerlines.

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Guideline Values			**5000**	**100**
Batterstown	Meath	Centreline	1468	0.8
		Within 50m	34	0.1
Croghan	Offaly	Centreline	767	0.5
		Within 50m	469	0.4
Grange More	Laois	Centreline	2376	2.0
Tinnacross	Offaly	Within 50m	7890*	2.2
Tinnacross (repeat)	Offaly	Within 50m	2713	0.9
		Centreline	954	0.1
Moneypoint	Clare	Within 50m	138	0.1
Newtown	Clare	Centreline	602	0.5
Carheeny More	Galway	Centreline	2900	0.8
Ballymarkahan	Clare	Within 50m	124	0.1
Carrow	Tipperary	Centreline	5248*	3.6
		Within 50m	4862	3.7
Carrow (repeat)	Tipperary	Within 50m	3896	1.7
		Centreline	3466	1.8
Ballincurry	Tipperary	Centreline	2554	1.8
Lackan	Galway	Centreline	495	1.2

Note: *Results above the Reference Level of 5,000 V/m.

Table A 4. ELF EMF results for 110 kV & 220 kV AC underground cables.

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Guideline Values			**5000**	**100**
Ringaskiddy	Cork	Centreline	3.51	1.04
Loughbeg	Cork	Centreline	0.52	0.49
Grand Parade, Cork city	Cork	Centreline	4.5	0.15
Kilnamanagh, Dublin city	Dublin	Centreline	1.9	0.12
Kilnamanagh, Dublin city	Dublin	Within 50m	1.32	0.43
Kilnamanagh, Dublin city	Dublin	Within 50m	62.8	0.29
Sandymount, Dublin city	Dublin	Centreline	2.4	0.3
Sandymount, Dublin city	Dublin	Within 50m	0.28	2.92

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Guideline Values			**5000**	**100**
Cabinteely	Dublin	Centreline	1.15	0.09
Coolough Road, Galway city	Galway	Centreline	6.4	0.09
Moyvane	Kerry	Centreline	133	0.04

Table A 5. ELF electric and magnetic fields measured nearby substations.

Location	County	Survey Type	Electric Field (V/m)	Magnetic Field (μT)
Guideline Values			**5000**	**100**
Corduff	Dublin	Within 50m	4.2	0.12
Ballygoman	Wexford	Within 50m	294.2	0.2
Cross Street, Cork city	Cork	Within 50m	3.54	0.55
Milltown, Dublin city	Dublin	Within 50m	0.6	0.4
Dunstown	Kildare	Within 50m	0.4	0.05
Dunstown	Kildare	Within 50m	2.1	0.04
Loughrea	Galway	Within 50m	7.5	0.04
Loughrea	Galway	Within 50m	10.8	0.04
Lacka East	Kerry	Within 50m	172	0.13
Milltown	Limerick	Within 50m	11.8	0.07
Castlebar	Mayo	Within 50m	383.1	0.1
Tullynagracken South	Sligo	Within 50m	42.5	0.1
Flagford	Roscommon	Within 50m	6.5	0.05