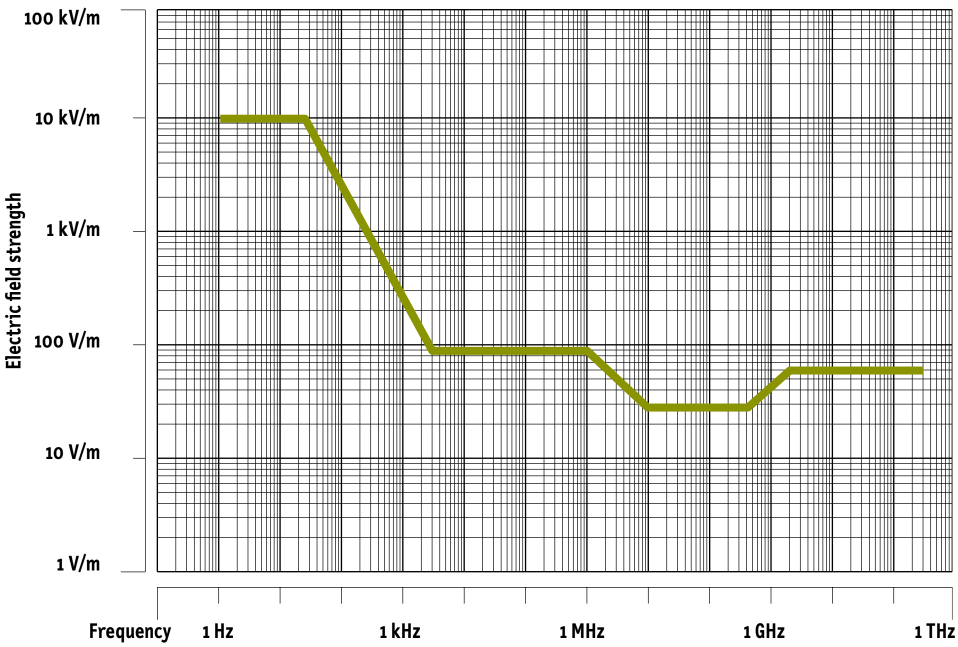
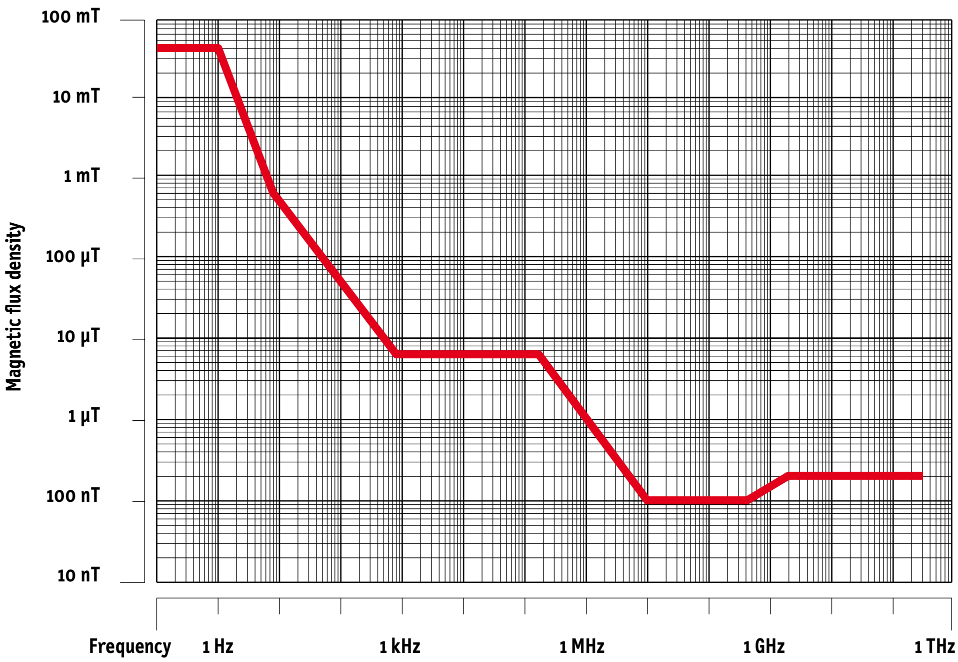
# Limitation of short-term exposure

The Ordinance specifies exposure limit values aimed at limiting short-term exposure. These limits are based on the recommendations of the International Commission on Non-Ionising Radiation Protection (ICNIRP) that are used in many other countries. If these limits are complied with, none of the scientifically accepted negative effects on our health can occur. These include an increase in body temperature due to very high intensity radiation from transmitters, and triggering of undesirable nerve impulses or muscle contractions by intensive electric or magnetic fields. The exposure limit values must be complied with wherever people spend any length of time.




**The exposure limit values for the electric field strength (green curve) specified in the ONIR vary according to the frequency of the radiation, since the effects on human beings occur at different intensities depending on frequency.**




**For the same reason, the exposure limit values for the magnetic flux density (red curve) are also frequency-dependent.**

| System | Frequency | Exposure limit value |
|---|---|---|
| Railway catenaries | 16.7 Hz | 300 µT and 10,000 V/m |
| High-voltage power lines | 50 Hz | 100 µT and 5,000 V/m |
| Radio/TV transmitters | 10 - 400 MHz | 28 V/m |
| Mobile phone | 900 MHz | 41 V/m |
| base stations | 1,800 MHz | 58 V/m |
| UMTS transmitters | 2,100 MHz | 61 V/m |

**Examples of exposure limit values for various frequencies.**

## Exposure limit values

- The exposure limit values specified by the Ordinance are internationally co-ordinated.
- They protect against scientifically accepted damage to health.
- They take account of the overall low-frequency or high-frequency radiation at a given location.
- They must be complied with wherever people spend any length of time (including very short periods).

# Precautionary limitation of long-term exposure

Exposure limit values ensure protection against recognised, acute effects, but they do not protect against suspected effects at lower radiation intensities, especially with long-term exposure. A great deal of research is still required in this area. When the Federal Council drew up the ONIR, it did not want to wait for further research findings, and for this reason it included precautionary measures to limit the long-term exposure.

The provisions concerned are based on the principle of precaution as established in the Federal Law relating to the Protection of the Environment. Article 1, paragraph 2 of this law states: "Early preventive measures shall be taken in order to limit effects which could become harmful or a nuisance". In other words, suspicion of harmful effects is sufficient, and it is therefore not necessary to provide scientific proof. In Article 11, the Environmental Protection Law also states that measures must be taken at the source to limit environmental pollution. Here the criteria are technical and operational feasibility, as well as economic acceptability.

The ONIR implements these principles by specifying thresholds for various categories of radiation sources. These so-called installation limit values apply to radiation from a single installation and are well below the exposure limit values. For mobile phone base stations they are around 10 times lower, and in the case of new high-voltage power lines they are as much as 100 times lower. Installation limit values must be complied with wherever people spend lengthy periods of time (at places of sensitive use). These provisions are among the most stringent regulations of their kind in the world.

However, in view of the unclear situation with respect to risks to health, even these stringent regulations do not provide 100-percent safety. It is not possible for authorities and medical experts to provide a guarantee of safety, either now or in the future. However, this holds not only for the radiation issue, but also for many other new technologies. It is not possible to exclude all potential health risks on a scientific basis, since life processes are too complex to allow every conceivable biological effect to be studied in advance. But since the installation limit values reduce long-term exposure, the risk of any consequences to our health that are not clearly recognisable today is also minimised.

## Installation limit values

- The installation limit values specified by the ONIR are of a precautionary nature.
- They are much lower than the exposure limit values.
- They are based on the principle of precaution established in the Federal Law relating to the Protection of the Environment, and have been specified in accordance with technical, operational and economic criteria.
- They limit the level of radiation from a given installation.
- They must be complied with wherever people spend lengthy periods of time.
- They ensure that exposure to electrosmog is low at places of sensitive use, and in this way they also reduce the risk of suspected harmful effects on health.

Installation limit values are based on technical, operational and economic criteria, and not on medical or biological findings. This means they are not levels indicating harmlessness, and compliance with them cannot guarantee that all harmful effects can be excluded. However, this also does not mean that negative effects occur if installation limit values are exceeded.

## Places of sensitive use

Precautionary protection provided by the installation limit values is limited to locations where people regularly spend lengthy periods of time. Here, long-term exposure shall be kept as low as possible. Places of sensitive use include apartments, schools, hospitals, offices and playgrounds, but do not include balconies and roof terraces, stairways, garages, storage and archive rooms, temporary workplaces, churches, concert halls and theatres, camp sites, sports and leisure-time facilities, passenger areas in railways, observation decks.

| System | Frequency | Installation limit value |
|---|---|---|
| Railway catenaries | 16.7 Hz | 1 µT (24-hr average) |
| High-voltage power lines | 50 Hz | 1 µT |
| Radio/TV transmitters | 10-860 MHz | 3 V/m |
| Mobile phone | 900 MHz | 4 V/m |
| base stations | 1,800 MHz | 6 V/m |
| UMTS base stations | 2,100 MHz | 6 V/m |

**Examples of installation limit values. These have to be complied with in the reference operating mode. Please refer to the descriptions of the various installation categories for more detailed information.**

**In order to protect the population, the designation of new building zones will only be permitted in close proximity to existing or planned supply installations emitting non-ionising radiation if the installations concerned are able to comply with the installation limit values specified in the ONIR.**

**New building zones**

In addition to measures at source, the ONIR also sets out to ensure the lowest possible long-term exposure by means of land use planning. It restricts the development zoning of new areas if they are in the close vicinity of existing or planned facilities that produce non-ionising radiation. In this way it ensures that no heavily exposed places of sensitive use will be created in the future. Since 1 February 2000, the definition of new building zones is only permitted if the installation limit values can be complied with.
The situation is different, however, in building zones that were approved before the above date and are located near a radiation source. Here, development is permitted without any restrictions, even if an installation limit value is exceeded. However the installation concerned has to be improved, and the ONIR specifies the required degree of improvement for each type of installation.
For example, mobile phone base stations must be improved in such a manner as to ensure that the installation limit value is fully complied with at all places of sensitive use, but no such requirements apply to power lines and railway catenaries. In the case of electricity transmission, the Ordinance merely calls for optimisation of the phasing arrangement, and in the case of catenaries a return conductor is required. Even though these measures do not suffice to bring the level of radiation below the installation limit value in developed areas, the Ordinance does not call for any other improvements. The Federal Council was of the opinion that a reduction of radiation levels to below the installation limit value would be disproportionate for existing power lines and catenaries. For the same reason it also rejected the idea of reversing zoning in areas that are already zoned.

# Controls by means of calculations and measurements

The competent federal, cantonal or municipal authorities verify whether the limit values specified by the Ordinance are complied with. For this purpose they may carry out calculations or measurements.
For example, operators of mobile phone base stations are required to submit a site data sheet together with their application for a building permit. The radiation in the vicinity of the installation is calculated on the basis of the transmission capacity and directions. The cantonal or municipal authorities check the accuracy of these data and calculations. Similar calculations are also carried out on other installations such as high-voltage power lines and railway catenaries.
The radiation can be measured after the system has been put into operation. Here a distinction is made between approval and control measurements.

**Approval measurements**

Approval measurements are carried out in order to ascertain that the respective installation limit value is complied with in a given operating mode – in the case of mobile phone base stations, for example, at full utilisation capacity and maximum approved transmission power. These measurements are normally carried out if calculations indicate that radiation levels are likely to exceed 80 percent of the specified installation limit value. It is often the case that the proprietor of the facility entrusts a specialised company with the task of carrying out these measurements, since such companies possess the necessary know-how and experience. The associated costs have to be borne by the proprietor in accordance with the principle of "polluter pays".
Approval measurements can never be carried out fully independently of the proprietor, since the latter is required to provide the necessary data concerning the current operating mode during the measurement procedure. In the case of mobile phone base stations, the Ordinance stipulates that the installation limit value must be complied with at full operating capacity and maximum transmission power. This status seldom applies in practice, however,

since the base station normally operates at lower output levels. For this reason, the results have to be projected from the current to the maximum approved transmission power. It is only in this way that the authorities are able to judge whether the installation limit value has been complied with. These projections are based on data provided by the operator concerning the current operating mode.

**Control measurements**

Control measurements are carried out for a quite different purpose, namely to determine the radiation level when the installation concerned is in its actual state of operation. Control measurements are carried out independently of the operator.

## Measurement of radiation from mobile phone base stations

There are various methods for measuring radiation from mobile phone base stations:

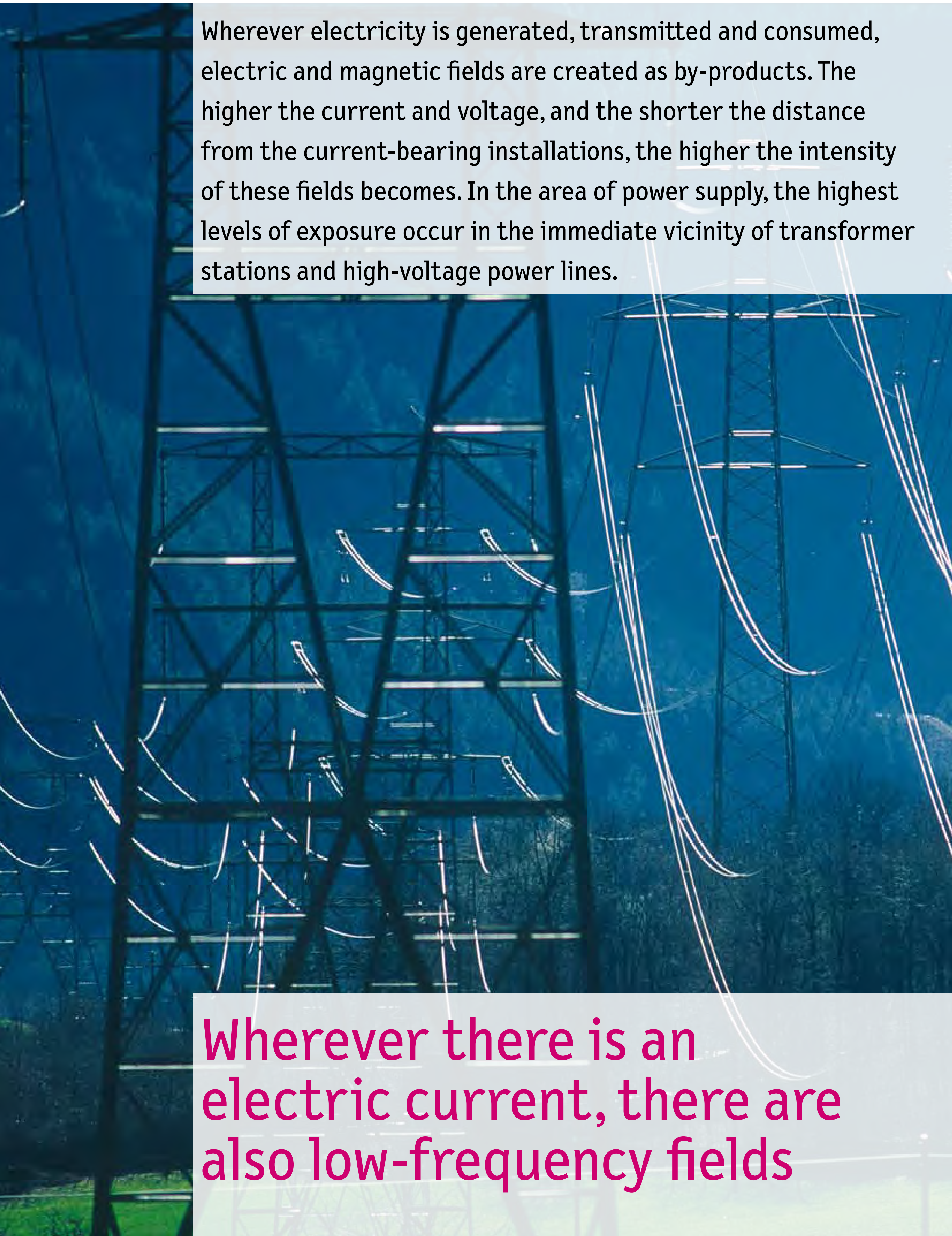
**Broadband measurement:** With this method, a sensor is used which records the overall radiation in a broad frequency range. Alongside mobile phone base stations, other systems such as radio and TV transmitters also contribute towards these readings, but it is not possible to distinguish between the individual sources.

**Frequency selective measurement:** This method is used if, on the basis of a broadband measurement, it is not possible to judge with sufficient certainty whether a mobile phone base station complies with the installation limit value. Here it is only the radiation from the installation concerned that is measured. Selective frequency measurements are more demanding and time-consuming than broadband measurements, and require more complex measuring equipment.

**Code selective measurement:** This method is used for measuring UTMS radiation if the other two methods fail to yield conclusive results. Here, only the temporally constant proportion from the UMTS signal is recorded, and subsequently projected. In this way it is possible to clearly allocate the recorded signals to a specific transmitter.

**This hand-held test antenna (above) can be used for detecting the maximum exposure level indoors. A spectrum analyser (below) depicts the results of the frequency selective measurement. Since each frequency is recorded separately, it is possible to specifically measure the level of radiation from a single mobile phone base station.**

Wherever electricity is generated, transmitted and consumed, electric and magnetic fields are created as by-products. The higher the current and voltage, and the shorter the distance from the current-bearing installations, the higher the intensity of these fields becomes. In the area of power supply, the highest levels of exposure occur in the immediate vicinity of transformer stations and high-voltage power lines.



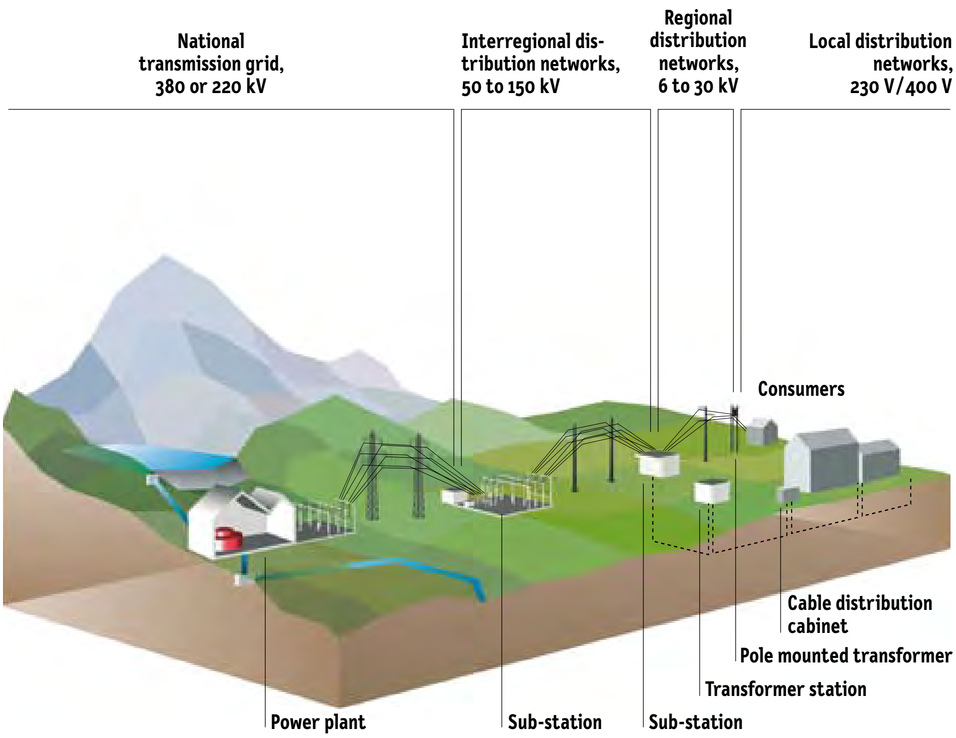
# Wherever there is an electric current, there are also low-frequency fields

Contents



## From power plant to mains socket

In Switzerland, a large proportion of electricity is produced from hydropower plants that are often located well away from places where it is subsequently consumed. This means that much of the energy we consume has already travelled a considerable distance. Generators in the various types of power plants generate electricity with a frequency of 50 Hz and a voltage of 6 to 27 kilovolts (kV).
High voltages reduce transmission losses, and in view of this, the voltage is increased in the respective power plant by means of transformers before the electricity is fed into the transmission grid. As a rule, levels of 220 or 380 kV are used for long-distance transport. This overland network mainly comprises overhead lines supported by pylons.
For shorter distances (e.g. region to region), the voltage is reduced to between 50 and 150 kV and the energy is usually transported via overhead lines supported by concrete masts.
And at the local level, the voltage is reduced to between 6 and 30 kV and the energy is transported either by underground cables or via overhead lines supported by wooden poles.
In residential areas, villages, etc., transformer stations finally reduce the voltage to the levels normally used in households (i.e. 230 and 400 volts).




**On its way from power plant to end user, electricity first has to be converted to higher voltages, then brought back down to lower voltages. Electric and magnetic fields are produced both along power lines and in the vicinity of transformer stations.**

## The three parameters of electricity

**There are three physical parameters which characterise electricity:**

**Current:** This is measured in amperes (A) and indicates how much electricity is flowing through a conductor. If we use water supply as an analogy, the current would correspond to the throughput of water per time unit. The greater the throughput, the higher the current. In households, fuses in distribution boxes or panels limit the current to 10 or 16 A. The largest high-voltage power lines are designed for currents of up to 2,500 A.

**Voltage:** This is measured in volts (V). To stay with the water supply analogy, this is equivalent to water pressure, which is still present even if the tap is turned off and no water is flowing. In the same way, a plugged-in power cable, e.g. for a bedside table lamp, is "live", even if the light is switched off and no electricity is flowing. General purpose batteries range from 1.5 to 12 V. The mains supply in households is 230 V, while high-voltage power lines can be up to 420,000 V.

**Frequency:** This refers to the number of oscillations per second, and it is measured in hertz (Hz) (1 Hz = 1 oscillation per second). Frequency is only of importance for alternating current. With batteries, the positive and negative poles are fixed. They supply direct current that always flows in the same direction. By contrast, alternating current changes its flow direction: electricity in households has a frequency of 50 Hz. And this frequency is always the same, from the power plant to the mains socket, whereas voltage and current change according to network level.

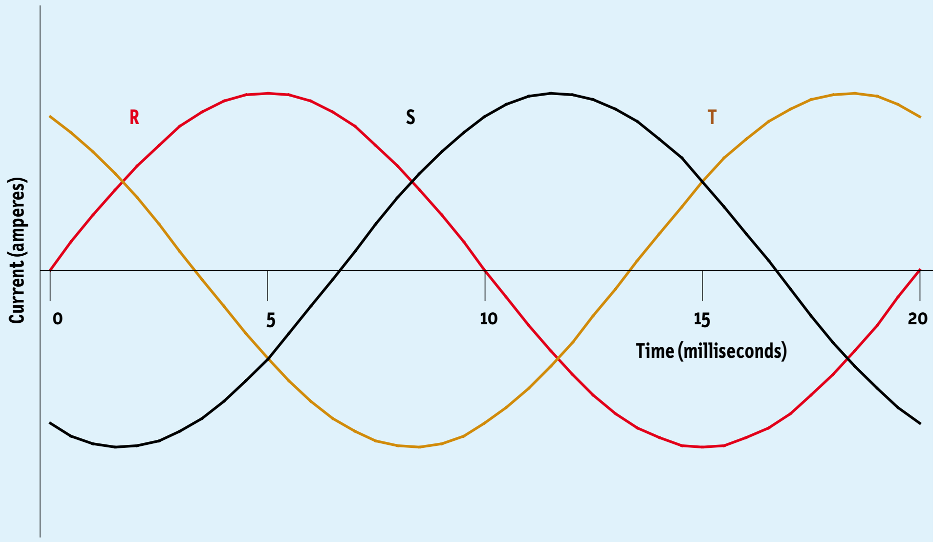
### How fields are created

Everyday we use electrical appliances and devices at home, at work and in our leisure time. And wherever electricity is used, electric and magnetic fields are created – for example in close proximity to high-voltage power lines, sub-stations and transformer stations. But these fields are also created by electrical appliances in households, offices, factories, etc.
Electric fields occur as soon as an appliance is connected to the power supply via a cable and plug. As soon as it is switched on, current begins to flow, and this gives rise to a magnetic field in addition to the already existing electric field. Since our power supply is operated with alternating current with a frequency of 50 Hz, the electric and magnetic fields are also 50 Hz alternating fields.

Some of the properties of electric and magnetic fields are similar: for example, in both cases they weaken rapidly with increasing distance from the source. However, they differ greatly when it comes to screening: electric fields can be screened fairly easily, whereas magnetic fields freely penetrate practically all materials, and screening is therefore only possible with the aid of special metal alloys or thick aluminium sheets, and even then only to a limited extent.

## Three-phase alternating current

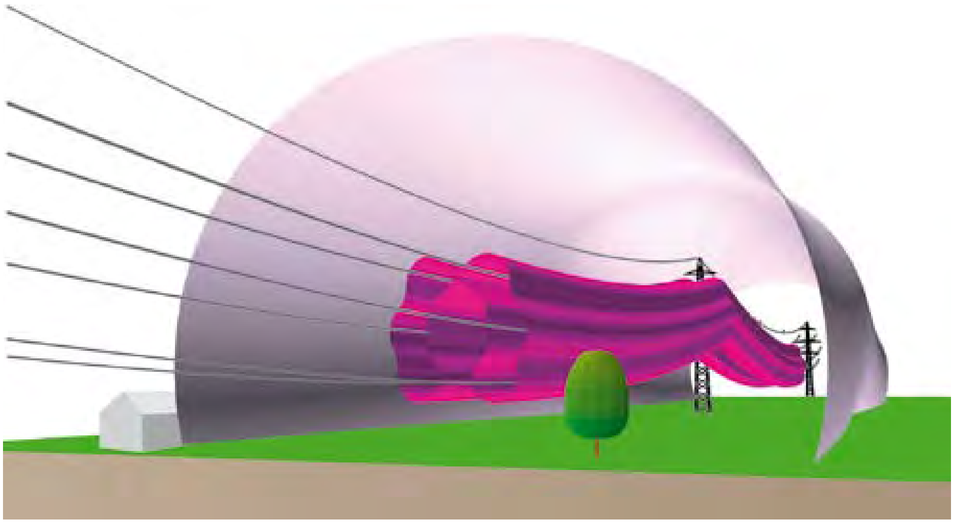
The 50 Hz electricity network is operated with three-phase alternating current. Here, three phase conductors form one line circuit. The alternating currents in each conductor are phase shifted by one-third of an oscillation period – they have differing phase angles. There are six different possible combinations for connecting the three phases (R, S and T) to the three phase conductors of a line circuit. As long as there is not a second circuit nearby, all six combinations generate an equally strong magnetic field. But as soon as two line circuits are brought close together, the magnetic fields of the individual circuits can be mutually strengthened or weakened. This depends on how the order of the phases of the second line circuit has been arranged in relation to the first one.



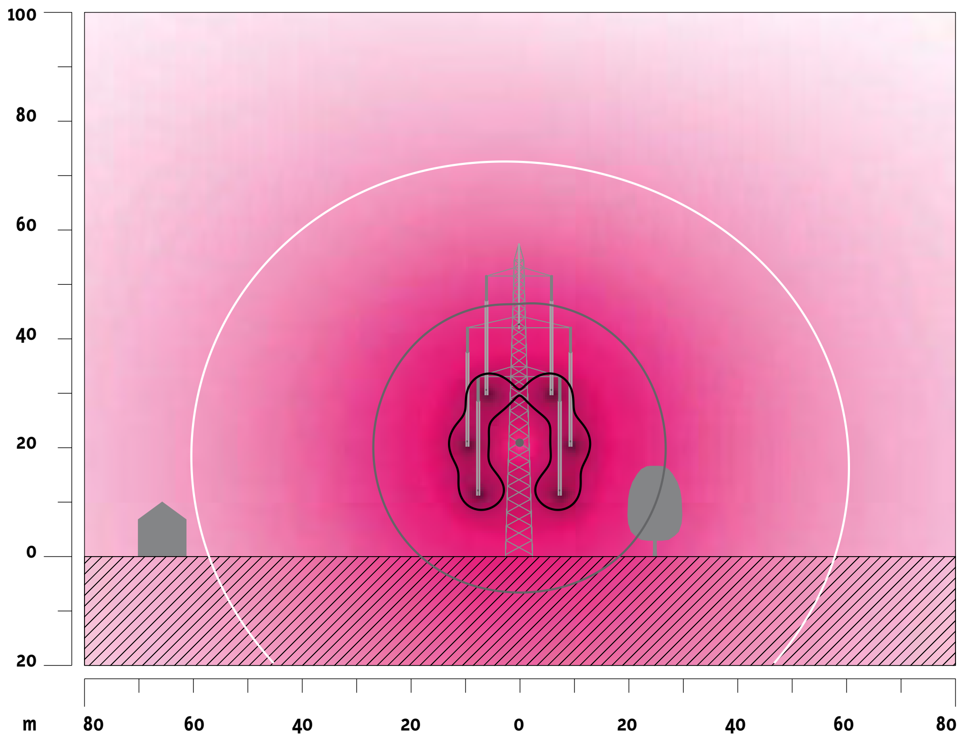

**With the three-phase alternating current system, the currents in the three conductors are each phase shifted by one-third of an oscillation period. The three phases are designated R, S and T.**

## Magnetic fields from overhead lines

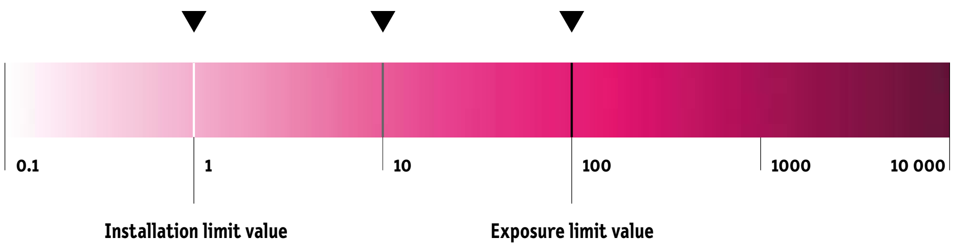
The intensity of a magnetic field is indicated in microtesla (µT). With high-voltage power lines, the higher the current, and the greater the distances between the power-bearing conductors, the greater the spatial bearing of the magnetic field. The most intensive exposure occurs at mid-span between two pylons, where the conductors are closest to the ground. The level varies, however, according to the design of the power line and the current. The magnetic field weakens with increasing distance from the power line. This means that the higher the conductors are above the ground, the weaker the field. In the case of transmission lines with several line circuits, or power lines running parallel to one another, the magnetic fields of the individual circuits can be mutually weakened or strengthened. Therefore it is possible to reduce the intensity of the magnetic field by optimising the order of the phases.
The walls of buildings cannot screen magnetic fields effectively. 380 kV overhead power lines can increase exposure to magnetic fields in neighbouring houses located up to a distance of 150 to 200 metres. Further away, exposure approaches the normal background level of approximately 0.02 to 0.04 µT which is usually encountered in residential dwellings connected to the electricity mains. However, the intensity can be much higher in the close vicinity of electrical appliances.



**View (in perspective) of the magnetic field of a typical 380-kV high-voltage transmission line with two line circuits at full load (1,920 A). The highest exposure occurs around the six current-bearing conductors: within the red tubes the level is more than 100 microtesla (µT), and at the perimeter of the large tunnel it has fallen to 1 µT.**



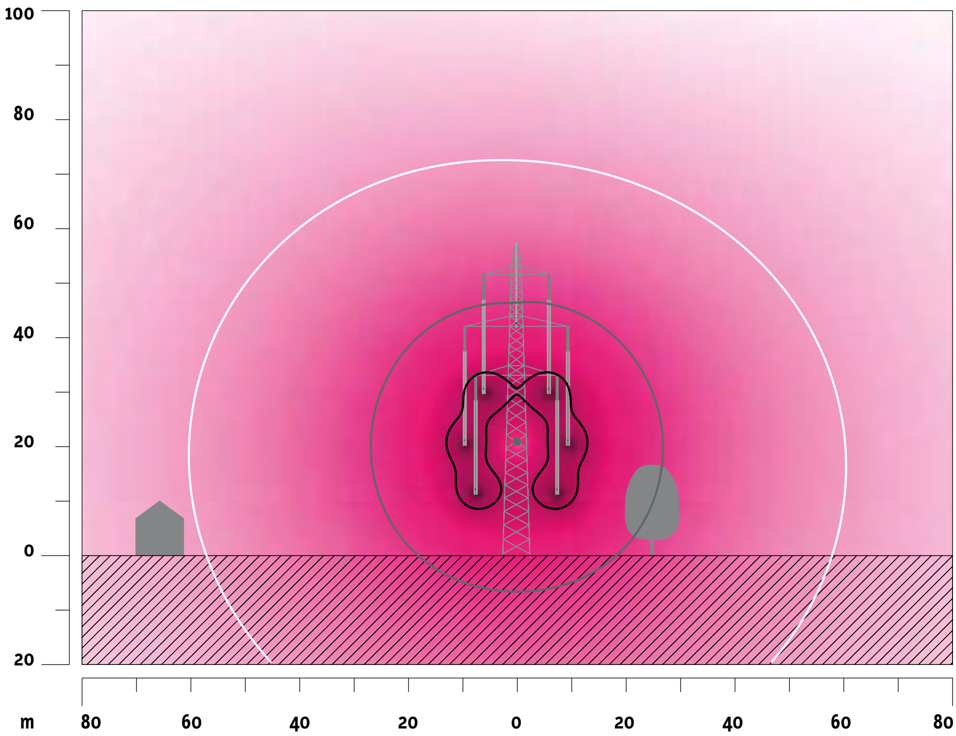

**Cross-section of the magnetic field of the high-voltage transmission line depicted above, at mid-span between two pylons where the conductors are closest to the ground. The exposure diminishes with increasing distance from the power line, and is not influenced by walls, trees or the ground. The significance of the concentric lines is indicated in the colour scale below.**



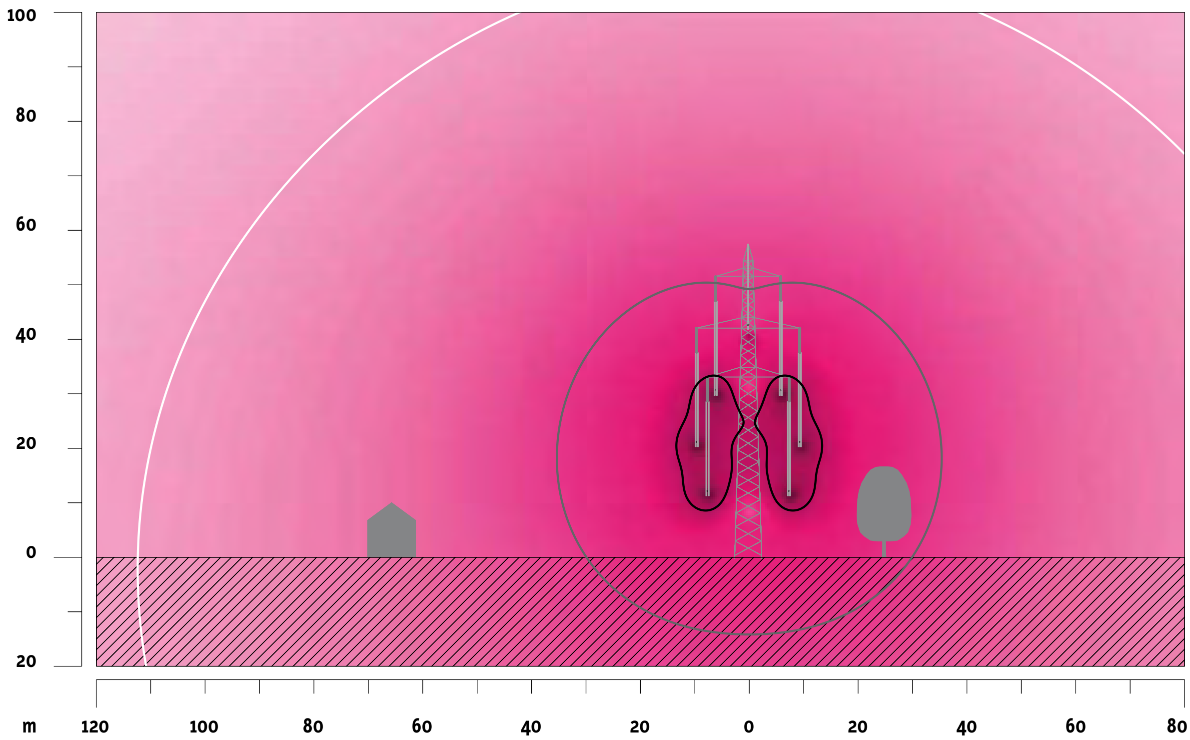

**Scale of magnetic flux density in microtesla (µT).**

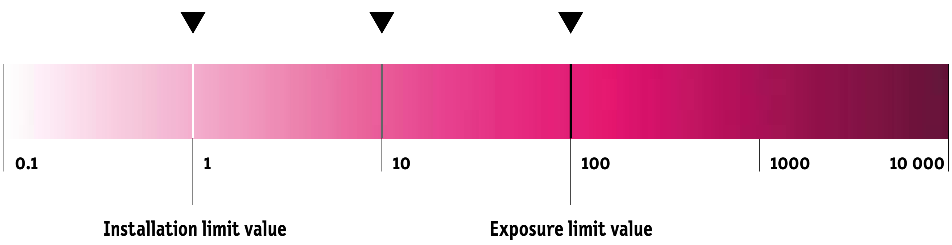
## Reduction of the magnetic field by phase optimisation

By contrast with electric fields, it is very difficult to screen magnetic fields. Careful arrangement of the conductors and optimisation of the order of the phases are the best options for limiting their reach. The alternating currents in each conductor are shifted in time with respect to each other – they are said to have different phase angles. Depending on the way in which the three phases are connected to the conductors at the ends of the transmission line, the magnetic field will be of smaller or larger spatial extension. Optimisation of the order of the phases means connecting the conductors in such a manner that the spatial extension of the magnetic field is minimised. For this purpose, simulation programs are used that calculate the most suitable order of the phases based on the given conductor arrangement and predominant power flow directions.




**With a favourable arrangement of the conductors and by optimising the order of the phases, it is possible to significantly reduce the spatial extension of the magnetic field. The illustration above depicts the magnetic field of a double-circuit 380-kV high-voltage transmission line with optimised phase order. The illustration below shows the same system with unfavourable phase order. The significance of the concentric lines is indicated in the colour scale.**

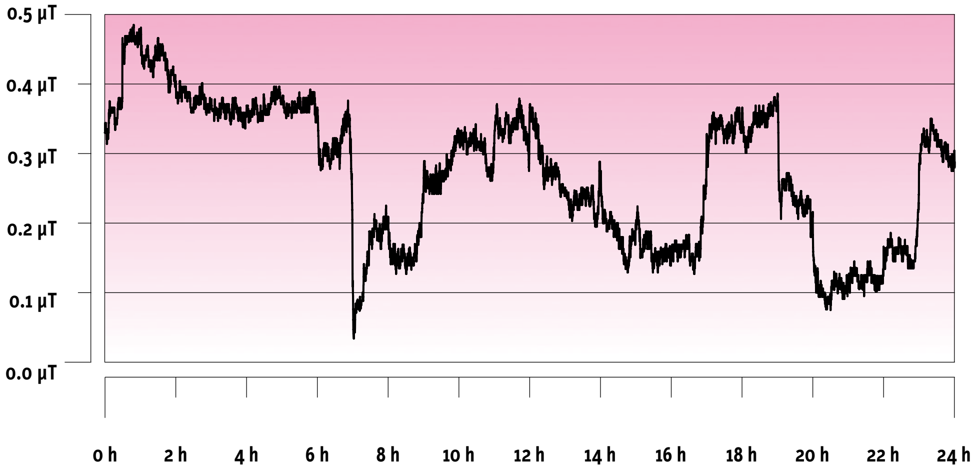



**Scale of magnetic flux density in microtesla (μT).**

**Temporal variation of the magnetic field near a high-voltage transmission line**

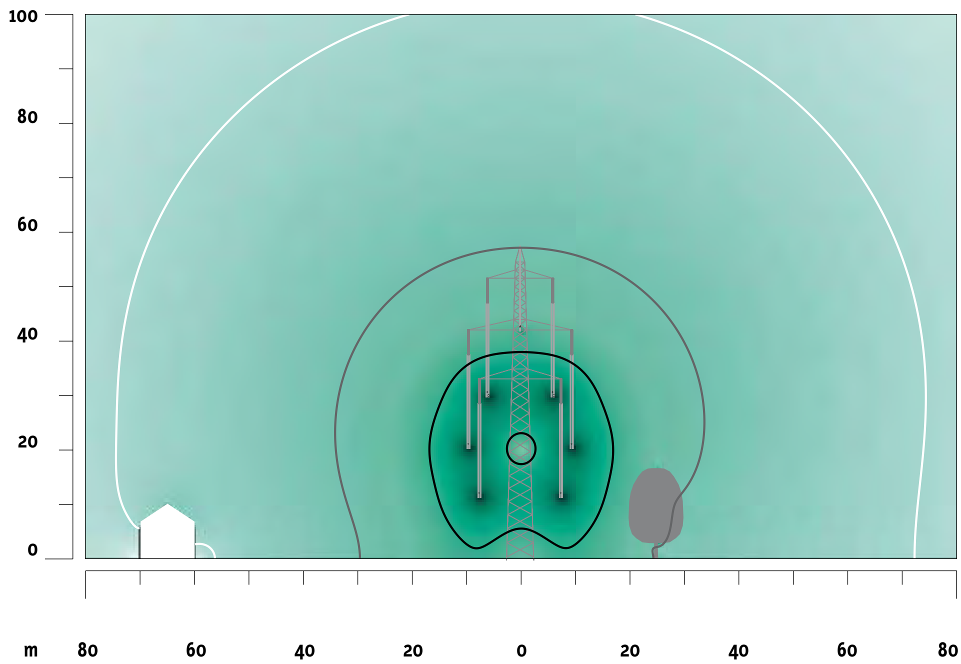
The magnetic field depends on the current, and thus on the corresponding electricity consumption in households, industry, etc. The time profile of magnetic field exposure in the vicinity of high-voltage power lines thus reflects the fluctuating electricity consumption, depending on time of day and season.
Unlike current, the voltage remains practically constant, and this also applies to the electric field of high-voltage power lines, which stays proportional to the voltage.



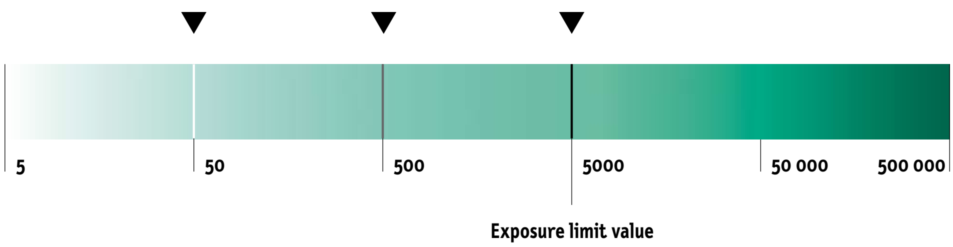

**Example of a 24-hour profile of the magnetic field near a 220 kV high-voltage transmission line on a weekday in January. The magnetic field fluctuates depending on the currents flowing through the two line circuits**

**Electric fields from overhead power lines**

The strength of electric fields is measured in volts per metre (V/m). It largely depends on the voltage and the distance from the conductor. Directly beneath a 380-kV high-voltage power line, the electric field strength close to the ground can reach 5,000 V/m. The lower the voltage, the less intense the electric field. For example, beneath a 220-kV line the strength is up to 3,000 V/m, for 110-kV lines it is a maximum of 700 V/m and for lines below 50-kV it is up to 400 V/m. As the diagram shows, the field strength weakens with increasing distance from the conductors. Electric fields can be distorted and weakened by low-conductive materials such as trees, bushes and buildings. The conductivity of building materials usually suffices to reduce an external electric field by 90 percent or more inside the building.




**Cross-section of the electric field of a 380 kV high-voltage transmission line with two circuits, at mid-span between two pylons where the conductors are closest to the ground (minimum permissible distance from the ground). Directly below the power line, the exposure limit value of 5,000 volts per metre is almost reached. Buildings, trees and the ground distort electric fields and attenuate them. This means that exposure inside buildings from overhead power lines can be more or less ignored. The significance of the concentric lines is indicated in the colour scale below.**



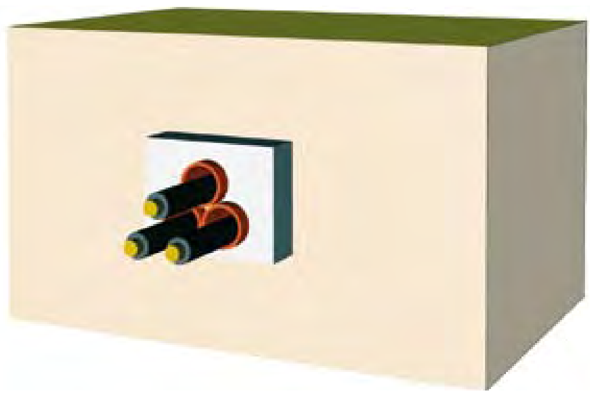

**Scale of electric field strength in volts per metre (V/m).**

## More localised magnetic fields from underground cables

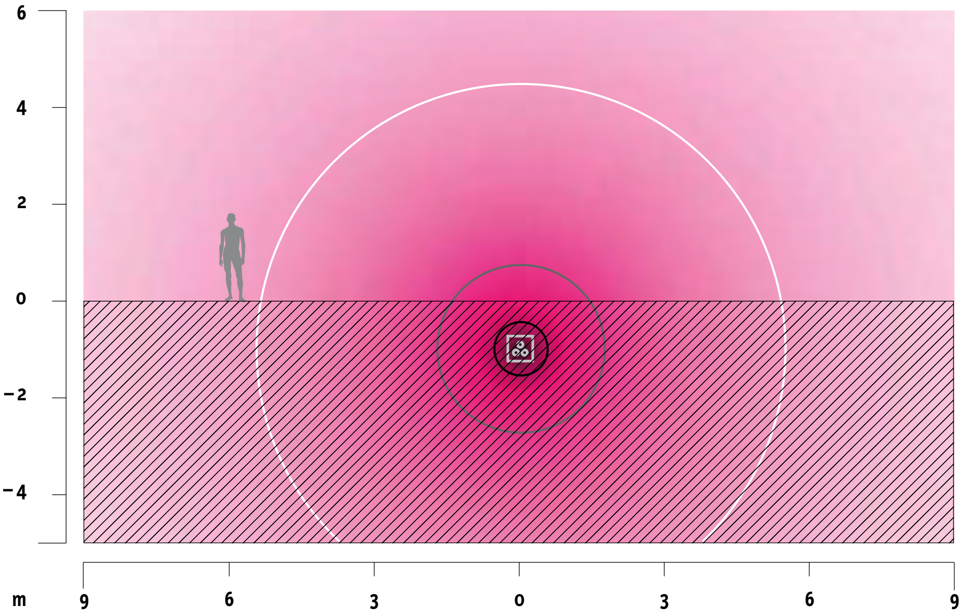
Whereas long-distance electricity transmission is primarily effected via overhead power lines, most local distribution is now carried out using underground cables.
With overhead lines, the air between the conductors acts as an insulator. The conductors have to be a certain distance apart in order to prevent arcing. But with underground cables, the conductors are very well insulated and can therefore be placed closer together, as a result of which the reach of the magnetic fields is reduced.
This means that, compared with overhead power lines carrying the same current, the magnetic field of an underground cable system has a much smaller spatial extension. Although the exposure may be just as high directly above an underground cable system as it is immediately beneath an overhead power line, it decreases more quickly on departing laterally than is the case with overhead lines.
Unlike the magnetic field, the electric field is completely shielded by the cable sheath and the soil. This means that no electric field is detectable even if we are standing directly above the underground cables.
Today it would be technically feasible to also lay high-voltage power lines (over 50 kV) underground, but the associated costs would be much higher, and repair work would be more costly and time-consuming. In view of this, electricity supply companies prefer to use overhead systems.

## Precautionary regulations of the ONIR

The precautionary emission limitations for high-voltage transmission lines specified in the ONIR vary according to whether the installation is new, to be modified or old.
**New installations:** At places of sensitive use such as residential dwellings, the installation limit value for new high voltage power lines or upon replacement of existing ones is 1 microtesla (μT). This limit applies to operation of the power line at full capacity. Since current varies according to time of day and season, and only rarely reaches full load, the average magnetic field exposure when the installation limit value is complied with is well below 1 μT. In certain exceptional circumstances, the relevant authorities may allow this limit value to be exceeded.
**Installations to be modified:** The term “modified” refers to all changes concerning conductor arrangement, phase order or operating status of an existing high-voltage power line. At places of sensitive use at which the installation limit value of 1 μT was already exceeded prior to the implemented changes, the magnetic field intensity may not be increased. At all other places of sensitive use, the installation limit value must be complied with. As with new installations, exceptions may be granted under certain circumstances.



**View (in perspective) of an underground cable line with three conductors in separated plastic tubes embedded in concrete.**



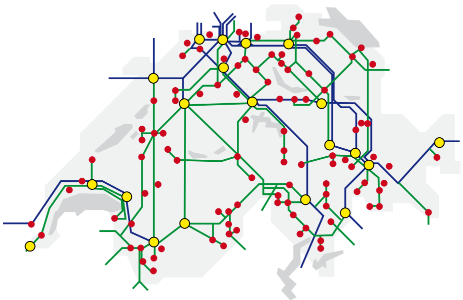

**Cross-section of the magnetic field of an underground cable line. Here the conduit is 0.8 metres below the surface. Since the current-bearing conductors (745 A each) are close together, the spatial extension of the magnetic field is significantly smaller than is the case with overhead transmission lines, and the exposure also diminishes more quickly with increasing distance.**

**220 kV overhead transmission line near Laax (canton of Grisons).**

Old installations: If old power lines exceed the installation limit value at places of sensitive use, the phasing has to be optimised. Beyond this the Ordinance does not specify any additional requirements. If the power line concerned does not comply with the installation limit value even after optimisation of phasing, this is tolerated.

| Type of power line | Distance for compliance with installation limit value of 1 µT |
|---|---|
| 380 kV overhead lines | 60 to 80 metres |
| 220 kV overhead lines | 40 to 55 metres |
| 110 kV overhead lines | 20 to 30 metres |
| 50 kV overhead lines | 15 to 25 metres |
| 110 kV underground cables | 3 to 6 metres |

The cited direct distances from the conductors apply when phasing is optimised. The higher the conductors are suspended, the shorter the minimum lateral distance for compliance with the installation limit value.

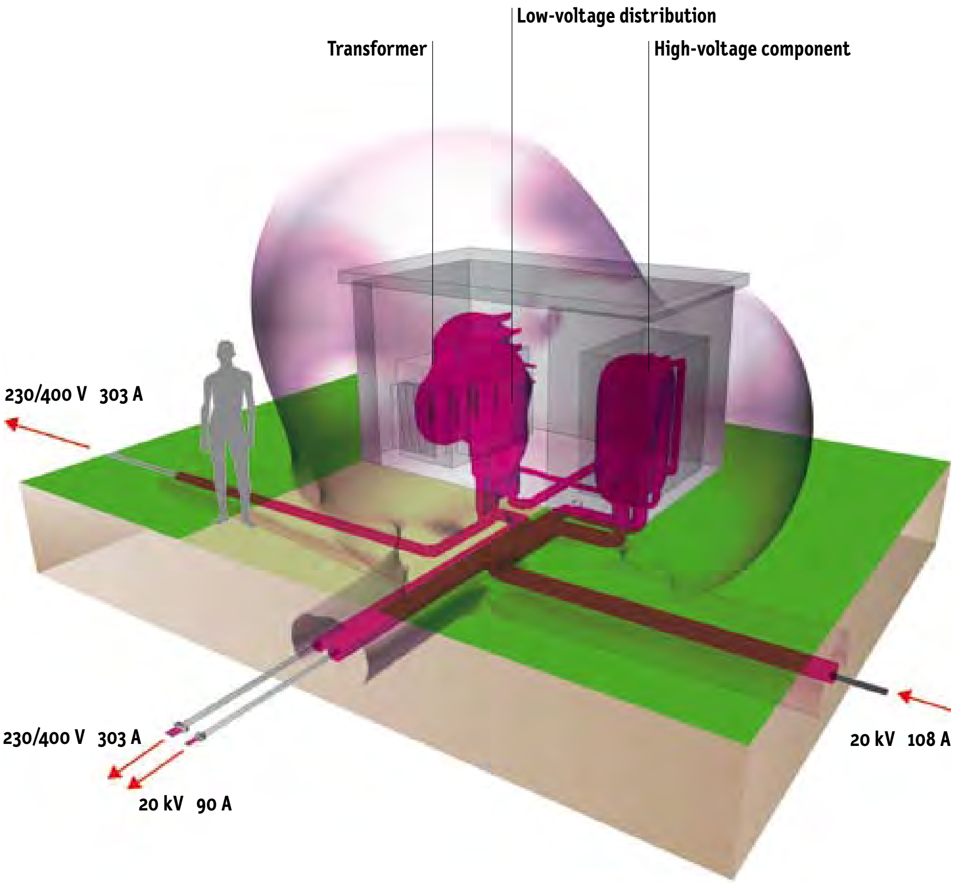


**The transmission grid in Switzerland (blue = 380 kV, green = 220 kV).**

**Magnetic field from a transformer station**

Transformers increase or decrease voltages. They are used in power plants, substations, residential areas and industrial zones. Transformer stations in residential areas are fed via the regional electricity distribution network. They change the supply voltage (which ranges from 6,000 up to 30,000 V) to the levels required for use in households (230 and 400 V). A basic transformer station comprises a high-voltage component, a transformer and a low-voltage distributor. Both the low-voltage distributor itself and its connection to the transformer generate the strongest magnetic fields. This is partly because the current is much higher here than it is on the high-voltage side, but also because the spatial separation between the individual conductors in the low-voltage distributor increases the magnetic fields still further.
Since there are numerous types of transformer stations, it is very difficult to make generally applicable indications of the magnetic fields they cause.

**In addition to high-voltage power lines, sub-stations, too, produce relatively intensive magnetic fields within their fenced-in area.**




**Depiction (in perspective) of the magnetic field of a walk-in transformer station at full load (630 kVA). In the dark-red sections, the magnetic field exceeds 100 µT, and at the perimeter of the lighter zone it is 1 µT. This is a well-designed transformer station with optimised components. The magnetic field of transformer stations that are not so well designed can have a much wider extension.**

In most homes, field exposure is not dominated by external sources, it is mostly caused by electrical appliances we use indoors. Here we ourselves are able to exercise precaution and reduce our level of exposure by taking basic measures. For example, we should avoid placing permanently operated electrical appliances in locations where people spend lengthy periods of time.

# Electrical appliances in the home are usually the main source of exposure

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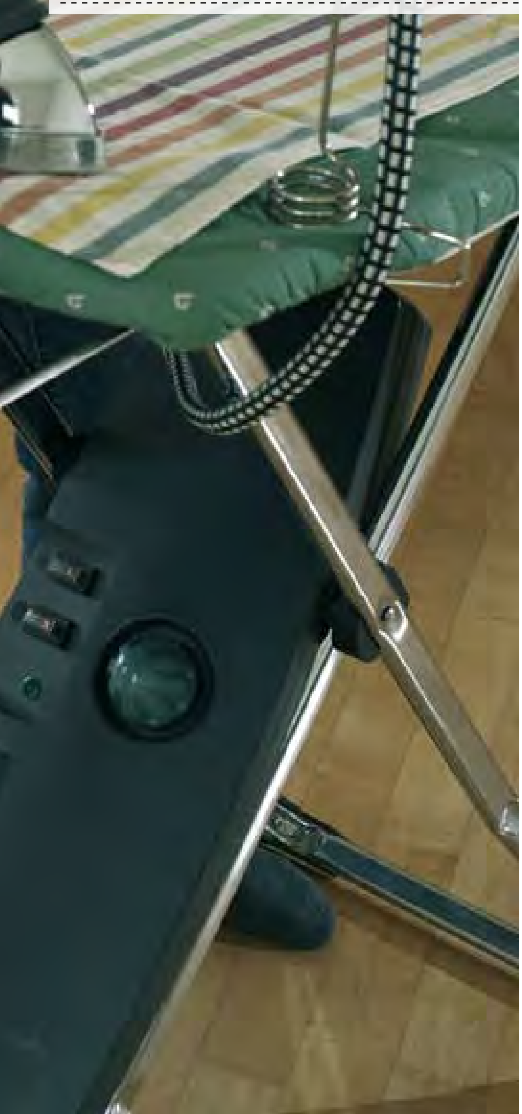

**Sources of electrosmog in households**

In our own home we can also be exposed to electrosmog from external sources such as nearby high-voltage power lines, railway catenaries, mobile phone base stations, etc., but in most cases a large proportion is in fact home-made. Electrosmog in households is made up of the following emissions:

- Low-frequency electric and magnetic fields from domestic installations, i.e. fixed distribution and fuse boxes/panels, electricity cables, mains sockets, as well as extension cables
- Low-frequency fields from lighting and electrical appliances
- High-frequency electromagnetic radiation produced by cordless phones or wireless networks for computers (see page 52).

**Increased exposure near electrical appliances**

In houses connected to the electricity mains, the typical background level of the magnetic field from the power supply is between 0.02 and 0.04 microtesla (μT). This applies to the vast majority of buildings that are located outside the area of direct exposure to sources such as high-voltage transmission lines, railway catenaries and transformer stations.

These exposures are normally superimposed by magnetic fields from electrical appliances inside the building. Exposure can be significantly higher in the immediate vicinity of appliances that produce strong magnetic fields:

- High consumption appliances that generate heat, e.g. cookers, boilers, hairdryers, clothes irons
- Appliances with magnetic coils or transformers, e.g. TV sets, low-voltage halogen lamps, clock radios
- Appliances equipped with an electric motor, e.g. drills, food mixers, vacuum cleaners.

In the case of hairdryers, for example, magnetic fields of more than 100 μT can occur directly on the casing surface, but their level diminishes quickly with increasing distance. Depending on the type of hair-

dryer, the magnetic field falls to between 0.01 and 7 μT at a distance of 30 centimetres, and to between 0.01 and 0.3 μT at a distance of 1 metre. A similar situation applies to electric cooker tops: in the immediate vicinity, their magnetic field is between 1 and 50 μT, but this weakens to 0.15 to 8 μT at a distance of 30 centimetres, and falls to between 0.01 and 0.04 μT at a distance of 1 metre.

**Appliances in permanent use**

As a rule, our exposure to magnetic fields from appliances like those cited above is only short term because they are not in permanent use. However, the situation is different when it comes to appliances that are in use all the time, e.g. clock radios. If such devices are used in places where people spend several hours a day (e.g. bedrooms, living rooms), this can lead to long-term exposure. It is possible to significantly reduce the level of exposure by maintaining an adequate distance from appliances that are permanently in use. In the case of a clock radio, for example, at a distance of around 1 metre the magnetic field is no greater than the background level in the building. Since magnetic fields are able to penetrate even solidly constructed walls at virtually full strength, it is important to also pay attention to the situation in neighbouring rooms when deciding where to place permanently operated appliances.

**Precautionary reduction of electrosmog**

There are several simple precautionary measures we can take to reduce the level of exposure to non-ionising radiation at home:

– Switching off and unplugging appliances. Appliances continue to consume electricity even in standby mode, and they therefore produce a magnetic field. If we switch them off when we no longer need them, the magnetic field also disappears. And if we even unplug such devices when we do not need to use them for longer periods, we can also eliminate the electric field.
– Maintaining adequate distance from electrical appliances. Since field intensity diminishes with increasing distance from the source, we should maintain an adequate distance between electrical appliances and our preferred spots of stay. The recommended minimum distance from clock radios is 1 metre, and from TV sets it is 2 metres. And since magnetic fields are able to pass through walls without obstruction, these distances also apply to appliances in neighbouring rooms.
– Avoiding the long term use of electrical appliances close to the body. Electrical installations and appliances that are in use for lengthy periods of time (e.g. electric floor heating systems) can cause high levels of exposure. This applies especially if appliances are used close to the body, as is the case with electric blankets and electric water beds. Here, too, switching off such appliances and unplugging them during the night reduces the level of exposure.

**Regulations governing new domestic installations**

The ONIR does not specify any installation limit value as a precautionary emission limitation for domestic electrical installations, but it does contain technical requirements concerning the arrangement of cables and distribution systems in order to reduce field intensities. All new installations have to correspond to the recognised status of technology. This includes star-shaped arrangements of power feeds (wherever possible), avoidance of loops in power feeds, and installation of main distribution systems at a sufficient distance from bedrooms.

**The ONIR applies to stationary installations and does not specify limit values for electrical appliances. But intensive magnetic fields also occur in the immediate vicinity of household appliances.**

**No limit values for electrical appliances**

In Switzerland, there are no legally binding limit values concerning non-ionising radiation from electrical appliances. Technical measures to reduce electric and magnetic fields are certainly desirable, but in order to avoid trade barriers, these need to be defined at an international level. Corresponding standards currently exist for computer monitors (e.g. TCO label).
The intensity of fields produced by electrical appliances must not be compared with the limit values specified by the ONIR for installations such as high-voltage transmission lines or transformer stations. Electrical appliances produce localised, non-homogeneous fields, whereas the limit values specified by the Ordinance apply to more extensive fields.

**Microwave ovens**

To cook foodstuffs, microwave ovens use the heat produced by high-frequency radiation with a frequency of 2.45 gigahertz (GHz). Thanks to screening and other protective measures, almost no radiation escapes from microwave ovens.
It is not possible to screen out radiation altogether, but as long as the microwave oven is intact, the amount of radiation that is able to escape through the door and seals is so low that it does not represent a health hazard. However, if the door seal should be heavily soiled or damaged, higher levels of radiation may escape under certain circumstances. The following measures can be taken to reduce radiation from microwave ovens:

– The door seal and casing should be checked periodically to make sure they have not been damaged. Microwave ovens that have been damaged or have been in use for several years should be checked by specialists, and replaced if necessary.
– Keep the eyes sufficiently away from the door while the microwave oven is in operation.
– A distance of at least 1 metre should be maintained from a microwave oven if it is used for a lengthy period of time.