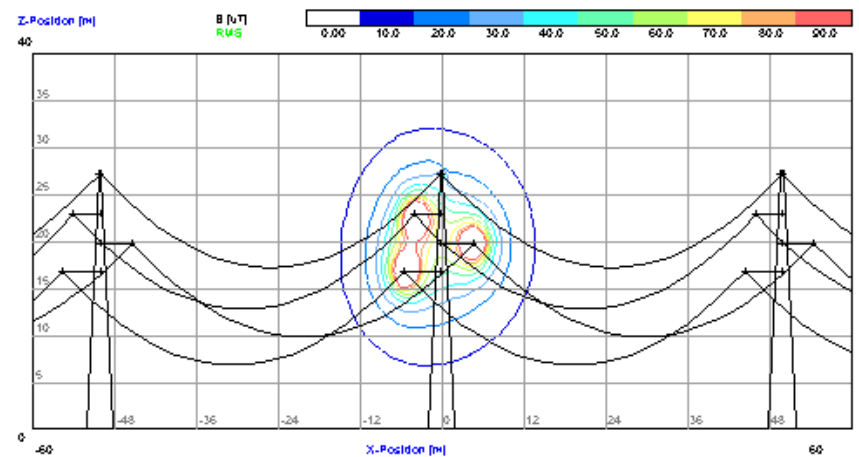


ELF EMF AND SLOVENIAN LEGISLATION



Elektroinštitut Milan Vidmar (EIMV)

1. Measurements and calculation of electric and magnetic fields (E and B)
2. Conformity assessment with environmental, labour and other legislation in this field
3. Monitoring of the views expressed by the scientific community in the field of protection of people against electromagnetic fields (ICNIRP, WHO, SCENIHR)
4. Monitoring of positions in the international CIGRE (WG C3.01 – EMF and health)

- Decree on electromagnetic radiation in the natural and living environment, Official Gazette of the Republic of Slovenia No. 70/96 and 41/04 – ZVO-1)
- Regulations on initial measurements and operational monitoring for sources of electromagnetic radiation and the terms of its implementation, Official Gazette of the Republic of Slovenia No. 70/96, 41/04 – ZVO-1 and 17/11 – ZTZPUS-1)

Date of publication: december 1996

EMF Sources in Sl. electric power system - (rated voltage above 1 kV):

- HV lines (voltages above 1 kV)
- HV cables (voltage above 1 kV)
- HV substations
- transformers and MV connections within the distribution transformer stations

The Decree and the Regulations in specific manner stipulate:

- **the limit values** of the magnitude of the electromagnetic field in the environment, **the levels of protection** against EMF in individual areas of the natural and living environment, **the method of determining and evaluating** the environmental stress caused by radiation and **measures to reduce** and prevent excessive EMF.
- **the types of quantities** of the electromagnetic field, which are the subject of the first measurements and operational monitoring of electromagnetic fields, **the methodology of measuring** the quantities, **the contents of the report** on the initial measurements and the operational monitoring, and the manner and form of reporting to the Ministry.

The Decree of EMF



The Decree separates:

- EMF sources on **existing** and **new (reconstructed)**
- natural and living environment on **I. areas** in **II. areas**

Limit values for E in B:

- The Decree (Article 4)

	Novi in rekonstruirani viri sevanja (I. območje)	Obstoječi viri sevanja ter Novi in rekonstruirani viri sevanja (II. območje)
Električno polje (<i>E</i>)	0,5 kV/m	10 kV/m
Magnetno polje (<i>B</i>)	10 μT	100 μT

- For reconstructions of overhead or underground line the Decree (Article 15) gives more mild conditions.

Specifics of the slovenian Decree and the Regulations define practice of measuring, calculation and evaluation of compliance with limit value.

system studies, reports of the impact on the environment, environmental reports, studies of variants, expert opinions and measurement reports (on initial measurements and operational monitoring) for new and existing electric power (EE) facilities ...

Initial system studies – 1349 (1998), 1479 (2002) in 1409 (1998) – gave preliminary estimations or findings for **some typical examples** with electric power system objects:

- HV (400 kV, 220 kV, 110 kV) overhead lines for max. currents: 400 A, 800 A in 1600 A
- MV (20 kV in 10 kV) lines for max. currents up to 300 A,
- transformer stations MV/LV.

Due to the requirements of the legislation, we made computational estimates for individual new EE facilities before siting and first measurement and operational monitoring after siting, and for individual existing EE facilities only measurements of operational monitoring.

For new EMF sources, the computational evaluation has evolved since 1996 from the initial general evaluation (2D) to more detailed spatial evaluations (3D) - (intensive development of information technology and more detailed spatial data, the availability of increasingly powerful tools for calculating E and B and integration of georeferenced data layers).

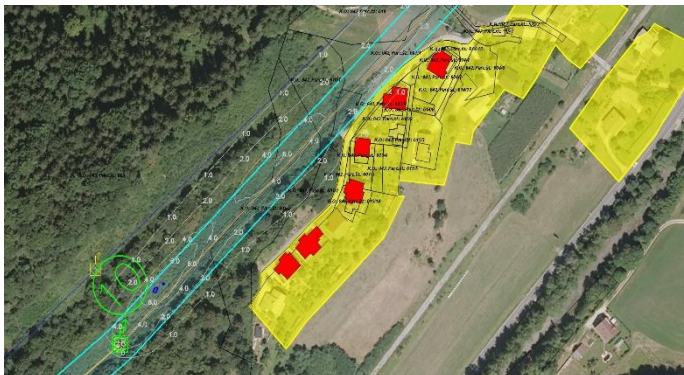
Procedure for power lines:

- GENERAL CALCULATIONS of EMF - an approximate corridor
- SPACE ANALYSIS - the inclusion of detailed spatial data (building cadastre, land cadastre parcel, intended use of space, ...) from which we obtain data on I. areas.
- CALCULATION FOR MICROLOCATIONS - integration of detailed spatial data regarding 3D geometry of EMF source, topology of terrain, building objects, digital orthophoto image and space information

Identification of areas for micro location analysis = searching for locations of I. areas inside the approximate corridor



I. areas (yellow colour) in approximate corridor

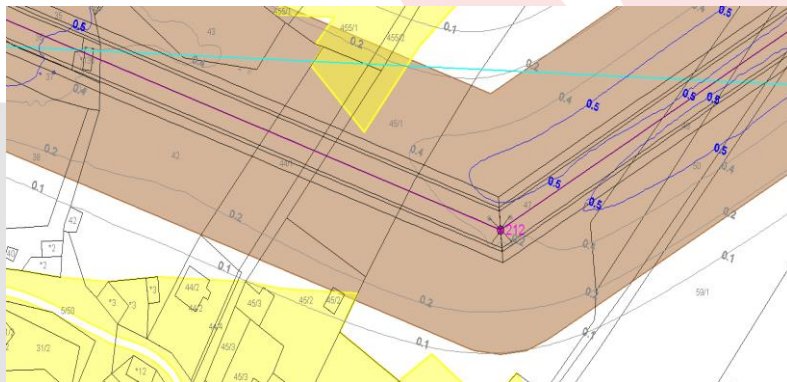


I. areas:
yellow colour – outside areas
red colour – buildings

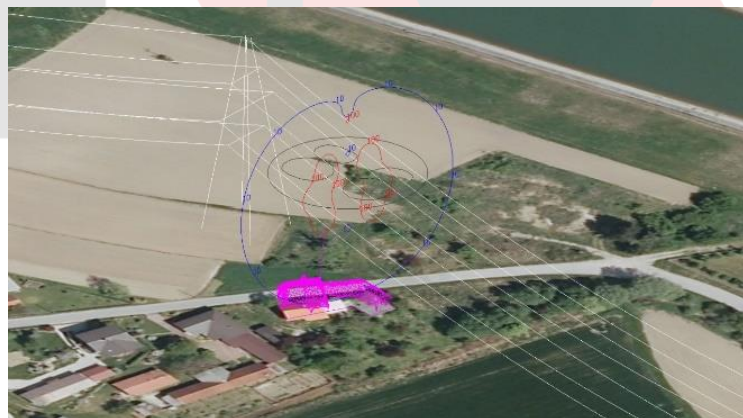
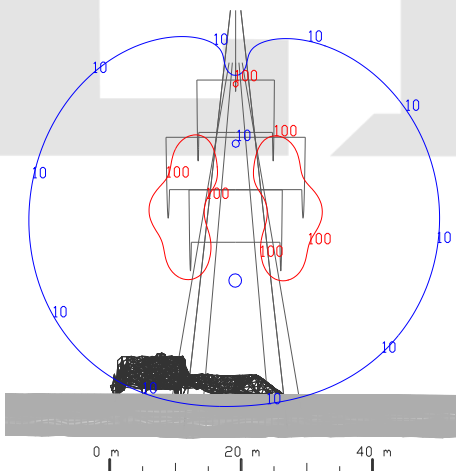
Micro-location analysis (HV overhead lines)



Examples of EMF evaluation and visualization – for HV OHL

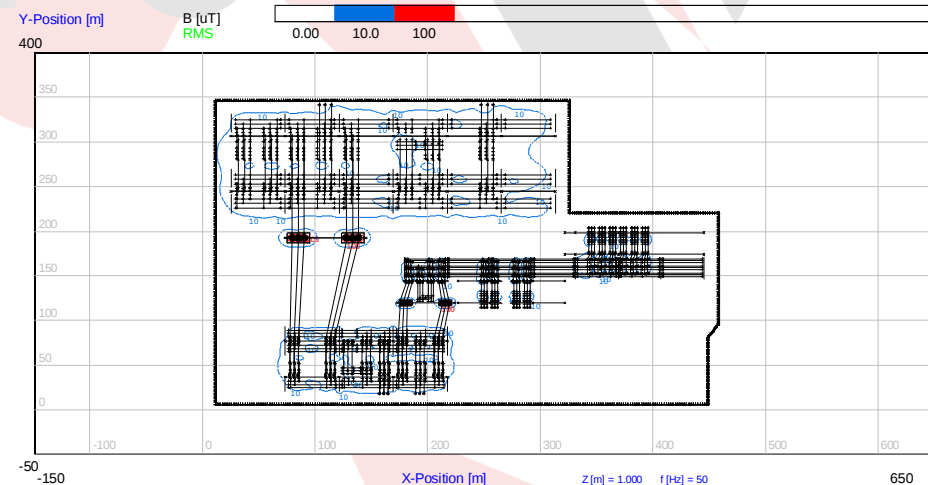
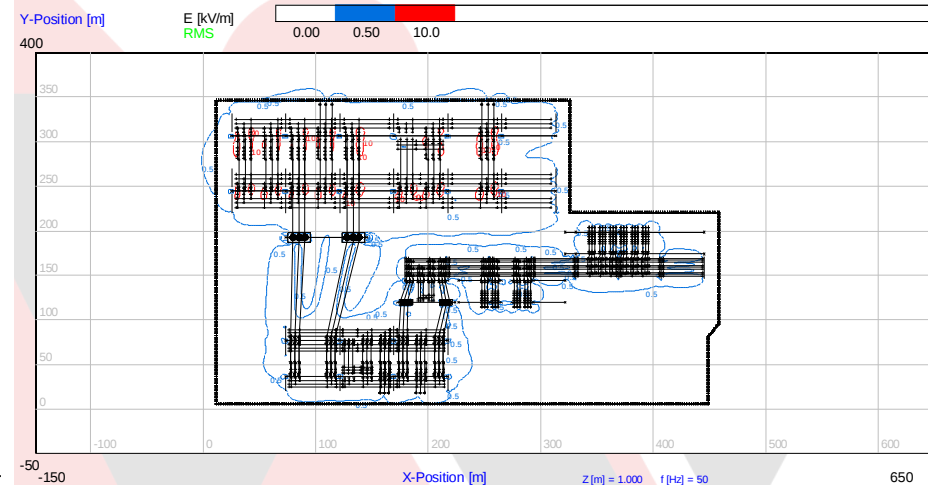
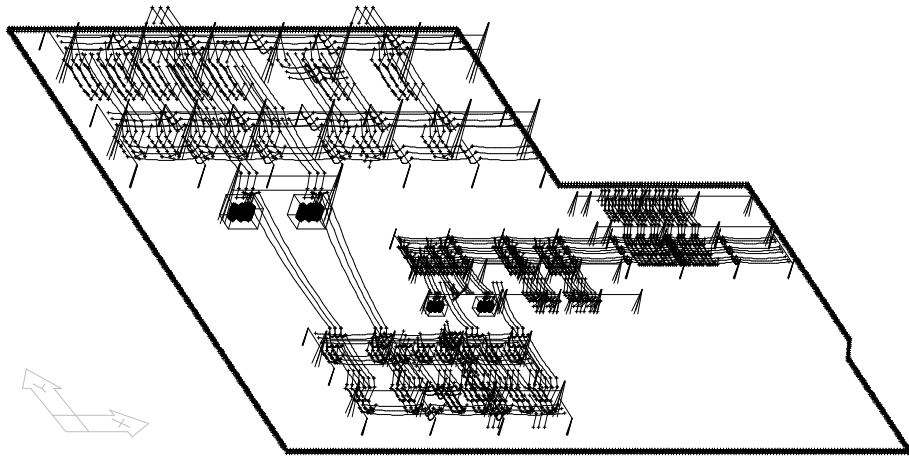


Ground plan calculation of electric field (included layers: land plot register, intended space use, protective zone, 3D model of overhead electric power line, E calculation results)



Magnetic field in transverse plane of OHL axis (included layers: 3D model of OHL, 3D model of building, building cadastre – analysed building, B calculation results)

Example of electric and magnetic field analysis results for substation: 3-D model



The fulfillment of requirements **for individual existing 110 kV (and higher) facilities** - is the implementation of periodic measurements (operational monitoring).

So far, we have produced more than 100 reports - no measurement of the exceeding of the limits of 100 μ T and 10 kV/m has been detected in the results of the measurements carried out according to the specifics of the provisions of the Decree and the Regulations.

more difficult to build new and reconstructed facilities /lines/ (for I. areas (buildings and open areas of intended space use for I. areas) it is necessary to provide significantly greater distances of OHL conductors to the ground or to the earthed objects as stated as minimal permissible in technical standards) – whether they have been achieved or not, it is determined individually in each case with micro-location analysis (with detailed EM model, for maximal load). With such calculation at micro-location it is verified that the limit values are not exceeded.

With carried out and foreseen reconstructions of OHL and with designing new OHL as new EMF sources - practice shows that it was and it will be because of the provision of the Decree and the Regulations when siting in the environment necessary to use sometimes measures as, for instance, horizontal moving of conductors, vertical moving of conductors (increasing height), use of other alternatives (classical, compacted, multi-system pillars or cable), change of intended space use or actual building use...

In the design of some new 110 kV cable lines, we also proposed, in cooperation with the designer, a greater depth of laying (several times in particular for coupling shafts if they are in I. areas) and also more optimal layout configurations.

- Regarding the circumstances in public opinion it is clear, that slovenian EMF environmental regulation – with strict limit values for new sources on I. areas – did not bring **no regression in the public concern about EMF health effects**. Many civil initiatives (CI) emerged against certain projects; they want compliance with even stricter limit values, most often they mention the value 0,4 μT .
- Currently there are at Ministry of environment in preparation drafts of new Decree and Regulations – what will their final version look like, it is not yet clear.
- EIMV commented on the drafts in terms of guidelines (we relied on positions of WHO, ICNIRP, SCENIHR, Council Recommendation (1999) and on position of CIGRE - WG C3.01.

Consensus of scientific community regarding potential long-term adverse effects of EMF is among other reflected through the position of WHO and international guidelines of ICNIRP. WHO as well as many other recognized scientific institutions conclude, that there is no clear and convincing evidence for long-term adverse effects of EMF.

From the views of the World Health Organization (WHO) on the health effects of EMS published in June 2007, it is clear that adoption of arbitrary low exposure limits is not recommended (neither for existing nor for new facilities). The basic international protection standard with the specified limit values is represented by the ICNIRP guidelines. The following is a translation of the quotation from the WHO website(vir: WHO, Backgrounder: Exposure to extremely low frequency fields, Junij 2007, <http://www.who.int/peh-emf/publications/facts/fs322/en/>):

» Regarding long-term effects, given the weakness of the evidence for a link between exposure to ELF magnetic fields and childhood leukaemia, the benefits of exposure reduction on health are unclear. In view of this situation, the following recommendations are given:

- Government and industry should monitor science and promote research programmes to further reduce the uncertainty of the scientific evidence on the health effects of ELF field exposure. Through the ELF risk assessment process, gaps in knowledge have been identified and these form the basis of a new research agenda.
- Member States are encouraged to establish effective and open communication programmes with all stakeholders to enable informed decision-making. These may include improving coordination and consultation among industry, local government, and citizens in the planning process for ELF EMF-emitting facilities.
- When constructing new facilities and designing new equipment, including appliances, low-cost ways of reducing exposures may be explored. Appropriate exposure reduction measures will vary from one country to another. However, policies based on the adoption of arbitrary low exposure limits are not warranted.«

WHO (source: <http://www.who.int/peh-emf/about/WhatisEMF/en/index1.html>):

»Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. However, some gaps in knowledge about biological effects exist and need further research.«)

»Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health.«

WHO (source: WHO Monografia 238, http://www.who.int/peh-emf/publications/elf_ehc/en/):

» Scientific evidence suggesting that everyday, chronic low-intensity (above 0.3-0.4 μ T) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukaemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukaemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.

A number of other diseases have been investigated for possible association with ELF magnetic field exposure. These include cancers in both children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications and neurological disease.

The scientific evidence supporting a linkage between ELF magnetic fields and any of these diseases is much weaker than for childhood leukaemia and in some cases (for example, for cardiovascular disease or breast cancer) the evidence is sufficient to give confidence that magnetic fields do not cause the diseasei.«

ICNIRP (source: <http://www.icnirp.org/cms/upload/publications/ICNIRPLFgdl.pdf>):

» It is the view of ICNIRP that the currently existing scientific evidence that prolonged exposure to low frequency magnetic fields is causally related with an increased risk of childhood leukemia is too weak to form the basis for exposure guidelines. In particular, if the relationship is not causal, then no benefit to health will accrue from reducing exposure.«

SCENIHR (source: http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_041.pdf):

» Health effects from Extremely Low Frequency (ELF) EF and MF

Overall, existing studies do not provide convincing evidence for a causal relationship between ELF MF exposure and self-reported symptoms.

The new epidemiological studies are consistent with earlier findings of an increased risk of childhood leukaemia with estimated daily average exposures above 0.3 to 0.4 μ T. As stated in the previous Opinions, no mechanisms have been identified and no support is existing from experimental studies that could explain these findings, which, together with shortcomings of the epidemiological studies prevent a causal interpretation.

Studies investigating possible effects of ELF exposure on the power spectra of the waking EEG are too heterogeneous with regard to applied fields, duration of exposure, and number of considered leads, and statistical methods to draw a sound conclusion. The same is true for behavioural outcomes and cortical excitability.

Epidemiological studies do not provide convincing evidence of an increased risk of neurodegenerative diseases, including dementia, related to power frequency MF exposure. Furthermore, they show no evidence for adverse pregnancy outcomes in relation to ELF MF. The studies concerning childhood health outcomes in relation to maternal residential ELF MF exposure during pregnancy involve some methodological issues that need to be addressed. They suggest implausible effects and need to be replicated independently before they can be used for risk assessment.

Recent results do not show an effect of the ELF fields on the reproductive function in humans. «

» Based on currently available scientific evidence, and considering the fact that the levels at which people are exposed are very low, there is no need to apply preventive measures regarding daily exposures to power frequency electric and magnetic fields. Present exposure limits recommended by international organizations offer adequate protection. «

Source: Reference paper: (M. Plante, P. Arnera, D.A. Brown, J.A. Bulcao, J. Lambrozo, S. Nakasono, M. Souques, H. Tripp: Living with electric and magnetic fields (EMF), ELECTRA, April 2017 (No. 291)

<https://www.cigre.org/article/GB/publications/reference-papers/living-with-electric-and-magnetic-fields-emf>

Additionally: Paper (M. Plante, J. Lambrozo, M. Souques, D.C. Brown, P. Arnera, J.A. Bulcao, S. Nakasono) 50-60 Hz magnetic fields and cancer, forty years of research: it is time to reassure, ELECTRA, June 2016 (No. 286)

<https://www.eles.si/Portals/0/Documents/porocila/Preveden%20in%20overjen%20clanek%20Electra%20%202016%20EMF%201016.pdf>

Starting point:

Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) and repealing Directive 2004/40/EC

- **Decree on the protection of workers against risks from exposure to electromagnetic fields (Official Gazette of the Republic of Slovenia, No. 49/16)**

Date of publication: 7.7. 2016