

ANALYSIS OF INFLUENCE OF ELECTROMAGNETIC FIELD ON LIVING AND WORKING ENVIRONMENT AND MITIGATION TECHNIQUES

Testing of electromagnetic field in living and working environment

DC field

- The testings are performed in the vicinity of HVDC power lines, MRI equipment, permanent magnets and other sources of DC magnetic field, as well as inside industrial and power facilities etc. [1].
- Testings performed in the vicinity of power lines are based on both measurements and calculations.



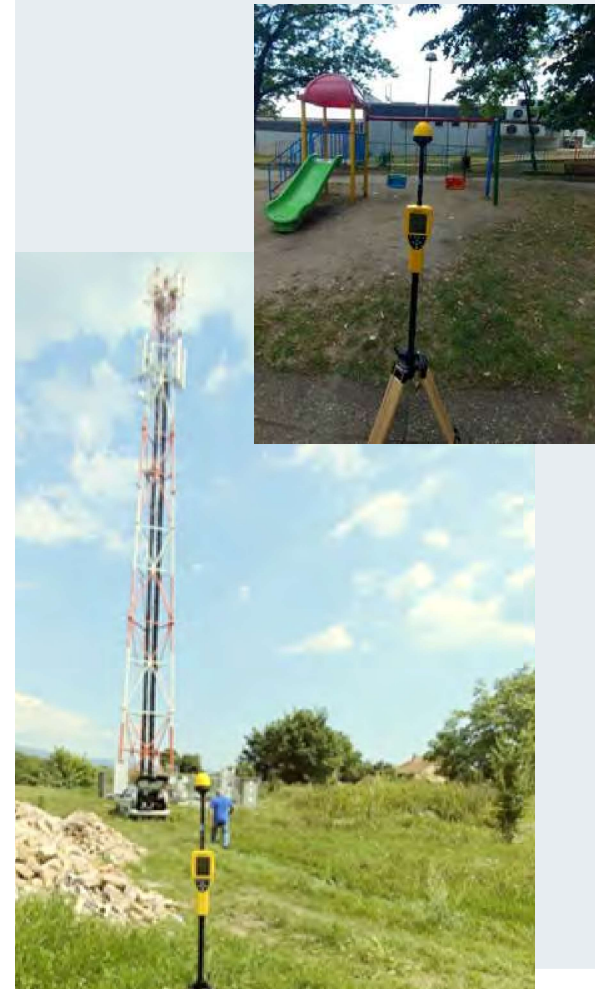
LF field

- The testings are performed in the vicinity of overhead and cable power lines, substations and other sources of low-frequency electromagnetic field, as well as inside power plants, substations, switchyards, industrial facilities etc. [2].
- The testings are based on both measurements and calculations of electric and magnetic fields.



VF field

- The testings are carried out in the vicinity of base stations, radio and TV transmitters, radars and other sources of high-frequency electromagnetic field [3].

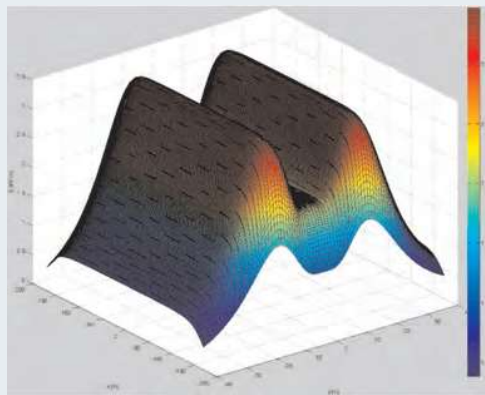


Projects and studies

Living environment

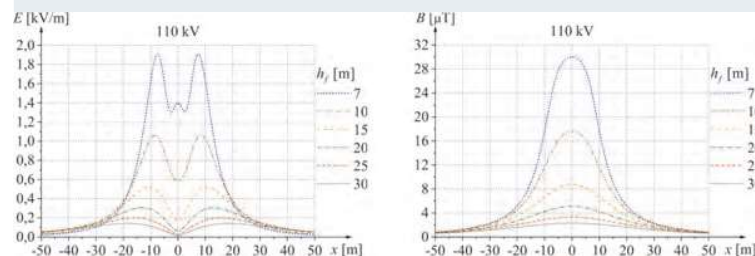
Expert evaluation studies

- Expert evaluation studies are carried out when it is necessary to evaluate the influence of new/reconstructed electromagnetic field source (overhead or cable power line, substation etc.) on the environment [4]. The study contains the results of measurements of existing level of electromagnetic field in the environment as well as the results of field calculations for the situation after the construction/reconstruction of the source.



Projects

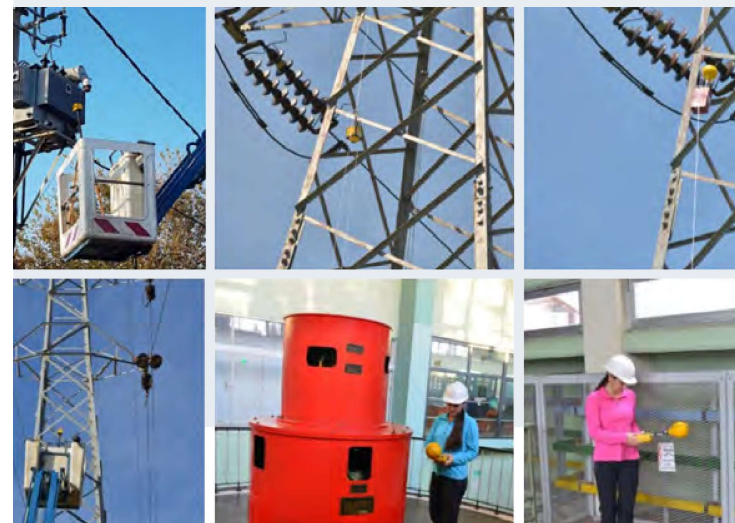
- Research projects are conducted in order to determine the influence of power lines, substations and switchyards on the environment.
- The project “Analysis of results of non-ionizing radiation testing in the vicinity of 110 kV, 220 kV and 400 kV overhead power lines” [5] analyzes the levels of electric and magnetic fields obtained by measurements and calculations in over 400 increased sensitivity areas located in the vicinity of the aforementioned power lines.



Working environment

Projects

- Research projects are carried out in order to assess the exposure of workers to electric and magnetic fields.
- The “Study on influence of electromagnetic field on workers during work in the vicinity of high voltage on 110-400 kV double-circuit overhead power lines” [6] analyzes the exposure of workers to electric and magnetic fields during work on double-circuit overhead power lines in the case when work is done on de-energized line while the other line on the same towers is in operation.
- In the project “Analysis of exposure of workers to non-ionizing radiation in Limske power plants and proposition of protection measures” [7] the assessment of exposure of workers inside Potpeć, Bistrica, Kokin Brod and Uvac power plants is conducted.
- In the project “Exposure of workers to electromagnetic fields during works in electric power facilities” [8] a detailed analysis of exposure of workers during work in the vicinity of 0.4 kV, 10 kV, 20 kV and 35 kV overhead and cable lines, as well as inside 10/0.4 kV, 20/0.4 kV, 35/x kV and 110/x kV substations is conducted.

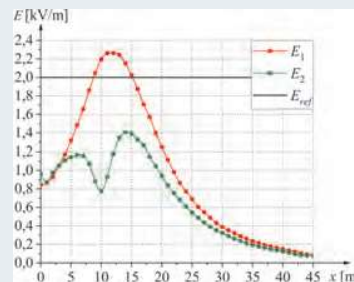


MEASURES FOR PROTECTION FROM ELECTROMAGNETIC FIELD IN LIVING AND WORKING ENVIRONMENTS

Overhead power lines



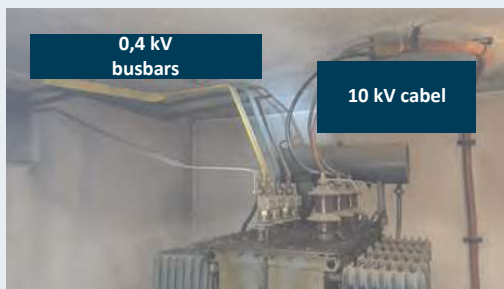
220 kV OHL



Measured values of electric field strength before and after the implementation of measures

- In the case when the testing shows that the reference levels of electric and/or magnetic field are exceeded it is necessary to apply certain measures in order to reduce the field levels [9].
- In order to select the most adequate technique for reducing the values of electric and/or magnetic field and predict the field values that will occur after the application of the selected technique, studies are carried out for each particular case [10].
- Mitigation techniques are most often applied to transmission overhead power lines and 10(20)/0.4 kV substations located in buildings

Substations



10/0.4 kV substation

- Maximum values of magnetic flux density in the apartment located above the substation before and after implementation of measures:

$B = 124,9 \mu\text{T}$ (before)
 $B = 4,6 \mu\text{T}$ (after)

References

1. Testing of DC magnetic field inside Kotor converter station and along the route of 500 kV cable line, 2020, commissioned by: Terna Crna Gora d.o.o.
2. Testings of low-frequency electric and magnetic fields inside and in the vicinity of substations and switchyards and in the vicinity of power lines, commissioned by: Serbian Transmission System and Market Operator "Elektromreža Srbije", Electric Power Industry of Serbia etc.
3. Systematic testings of high-frequency electromagnetic fields in the environment in the vicinity of base stations and radio and TV transmitters, 2018, commissioned by: Ministry of environmental protection.
4. Expert evaluation studies regarding influence of new/reconstructed electromagnetic field sources (overhead and cable lines, substations etc.) on the environment, commissioned by: Serbian Transmission System and Market Operator "Elektromreža Srbije", Electric Power Industry of Serbia etc.
5. "Analysis of results of non-ionizing radiation testing in the vicinity of 110 kV, 220 kV and 400 kV overhead power lines", 2018-2019, commissioned by: Serbian Transmission System and Market Operator "Elektromreža Srbije".
6. "Study on influence of electromagnetic field on workers during work in the vicinity of high voltage on 110-400 kV double-circuit overhead power lines", 2016-2018, commissioned by: Serbian Transmission System and Market Operator "Elektromreža Srbije".
7. "Analysis of exposure of workers to non-ionizing radiation in Limske power plants and proposition of protection measures", 2018-2019, commissioned by: Electric Power Industry of Serbia, Limske power plants.
8. "Exposure of workers to electromagnetic fields during works in electric power facilities", 2019-2020, commissioned by: Electric Power Industry of Serbia.
9. "Techniques for reducing electric and magnetic fields", 2013-2014, commissioned by: Serbian Transmission System and Market Operator "Elektromreža Srbije".
10. Studies regarding measures for reducing the levels of electric field strength and magnetic flux density in the vicinity of overhead power lines and substations, commissioned by: Serbian Transmission System and Market Operator "Elektromreža Srbije", ODS „EPS Distribucija“, d.o.o. etc.