Low Frequency Electromagnetic Radiation (50 Hz)

Electromagnetic radiation is combination of oscillating electric and magnetic fields that spread through space in form of electromagnetic waves. Near each electrified body there is an electric field while magnetic field is produced around a conductor through which an electric current flows.

Nowadays, electricity is present in all the places where modern man lives, works and moves, which means that people and other living beings are exposed to the electromagnetic radiation of weaker or stronger intensity. Therefore, in the last few decades, great attention has been paid to the study of the impact of electromagnetic fields on living beings, primarily to humans. Based on survey results, many organizations, such as The World Health Organization (WHO), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), International Radiation Protection Association (IRPA), etc., make recommendations including, inter alia, established limits of the intensity of electric and magnetic fields which living beings can be exposed to, as long as this exposure does not affect their health.

There is a recognized need to regulate this area that was done by adopting laws and accompanying subordinate regulations. In Montenegro, the Law on Non-Ionizing Radiation Protection was adopted in 2013, published in the "Official Gazette of Montenegro", No. 35/2013, and has been applied since 1 June 2015. Rulebook on permissible limits of exposure to electromagnetic fields was published in the "Official Gazette of Montenegro", No. 6/2015, and has also been in application since June 1, 2015. This Rulebook prescribes permissible electromagnetic fields exposure limits which subject population and occupationally exposed persons may be exposed as well as the allowable limit for areas of increased sensitivity.

The values provided in the Rulebook relevant for the electromagnetic radiation of low frequency (50 Hz) are systematized in Table I.

Table I. Reference levels

REFERENCE LEVELS OF RELEVANT PHYSICAL QUANTITIES FOR GENERAL PUBLIC EXPOSURE OF THE POPULATION			
Frequency range	Electric field strength, E [V/m]	Magnetic field strength, H [A/m]	Magnetic induction , B [μT]
25 – 50 Hz	**5000**	**160**	**200**
AREAS OF INCREASED SENSITIVITY			
Frequency range	Electric field strength, E [V/m]	Magnetic field strength, H [A/m]	Magnetic induction, B [μT]
25 – 50 Hz	**1250**	**40**	**50**

REFERENCE LEVELS OF RELEVANT PHYSICAL QUANTITIES FOR GENERAL PUBLIC EXPOSURE OF THE POPULATION				
warning values for exposure to electrical fields		**warning values for exposure to magnetic fields**		
Low warning values of the electric field strength E [V/m] (RMS)	High warning values of the electric field strength E [V/m] (RMS)	Low warning values of magnetic induction B [μT] (RMS)	High warning values of magnetic induction B [μT] (RMS)	warning values of magnetic induction for exposure of limbs to a localized magnetic field [μT] (RMS)
$5{,}0 \times 10^5/f$ **(10000)**	**$1{,}0 \times 10^6/f$** **(20000)**	**$1{,}0 \times 10^3$** **(1000)**	**$3{,}0 \times 10^5/f$** **(6000)**	**$9{,}0 \times 10^5/f$** **(18000)**

Measurements of the intensity of electric and magnetic fields conducted by an accredited institution at the request of CGES

400 kV OHL Podgorica 2 – Tirana

Along the route of the 400 kV OHL Podgorica - Tirana six characteristic locations were selected and viewed as the most critical with respect to the vicinity of the power line to the areas in which it is realistic to expect the presence of population (existing residential buildings, road intersections, etc.). Measurements at these locations were carried out at 436 measurement points. The maximum values have been selected and shown in Table II

Table II

Location	Location description	The maximum value of the electric field intensity measured at location E [V/m]	The maximum value of magnetic induction measured at location B [μT]
Location 1	-Residential and other facilities can be found at the subject location -The subject OHL intersects the road Podgorica - Mareza	**3362**	**2.083**
Location 2	- Residential and other facilities can be found at the subject location	**828**	**0.236**
Location 3	- Residential and other facilities can be found at the subject location - The subject OHL crosses Morača river - there can be found low voltage lines	**185**	**0.271**
Location 4	-Residential and other facilities can be found at the subject location - Terrain inclination	**1795**	**1.218**
Location 5	- The subject OHL crosses a local dirt road	**2663**	**2.090**
location 6	- there is a residential facility at the subject location - The subject OHL crosses a	**1397**	**1.490**

	local asphalt road		

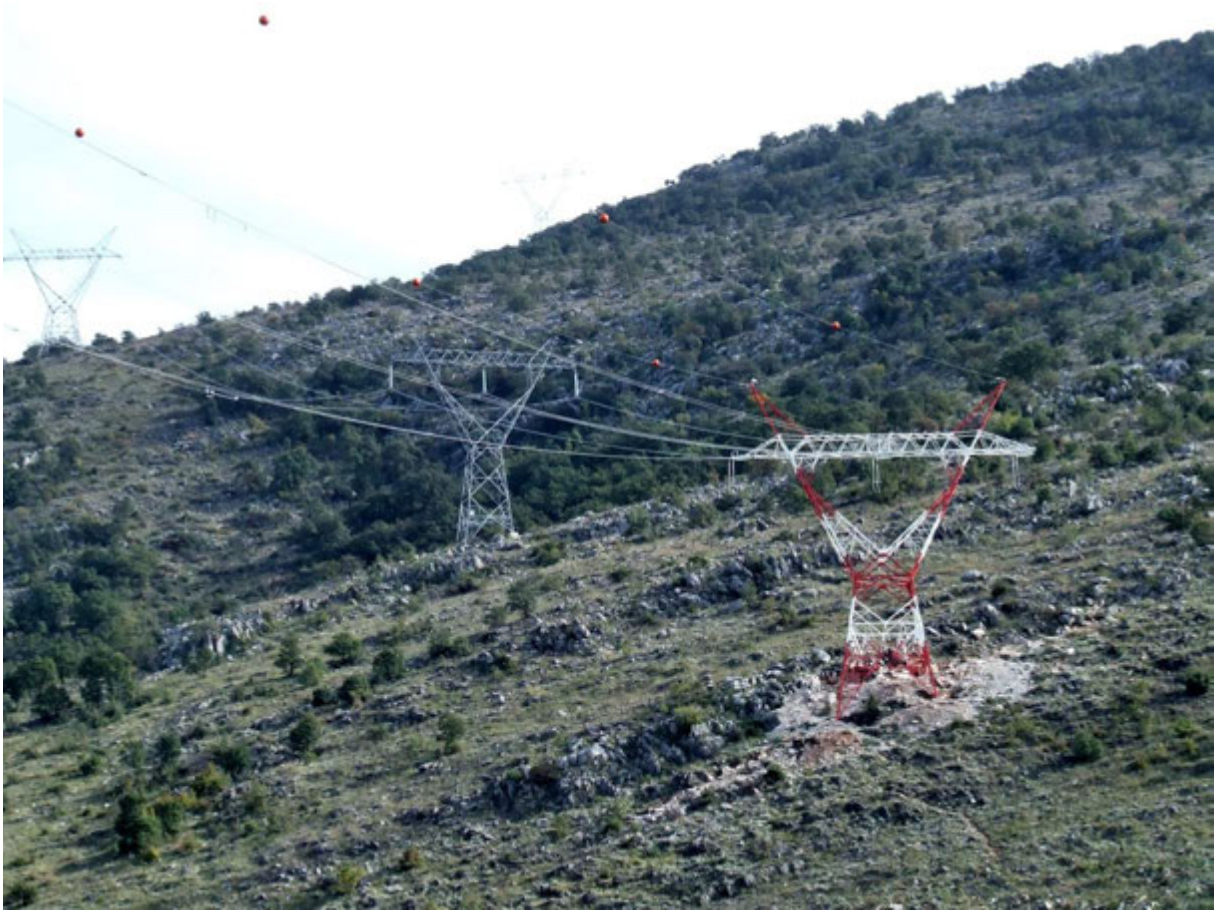

Image 1. 400 kV OHL Podgorica-Tirana

SS 400/110 kV Ribarevine

Measurements of the strength of electrical field and magnetic induction were conducted to assess the impact of SS Ribarevine and associated overhead lines to population residing in the vicinity of the substation. The measurements were carried out at 127 measurement points. Based on the results of the measurements, the maximum values have been selected and shown in Table III.

Table III

Location	The highest value of the electric field strength measured at location E [V/m]	The highest value of magnetic induction measured at location B [μT]
Along the highway Bijelo Polje - Podgorica by the fence of the substation on the side of rod towards the substation	**564**	**0.817**
by the fence of the substation	**3011**	**2.086**
Along the highway Bijelo Polje - Podgorica by the fence of the substation on the side of rod towards residential buildings	**460**	**0.514**
Directly in front of the existing residential or business facilities	**89**	**0.427**

Image 2. SS 400/110 kV Ribarevine

SS 400/110 kV Podgorica 2

SS Podgorica 2 is located in a residential neighborhood of Tološi in Podgorica. The measurements were carried out within the sub-station, around the fence of the substation and at the intersection points of 400 kV transmission line with local road towards Mareza, at a total of 74 measuring points. Based on the results of the measurements the maximum values have been selected and shown in Table IV.

Table IV

Location	The highest value of the electric field strength measured at location E [V/m]	The highest value of magnetic induction measured at location B [μT]
by the fence of the substation, directly beneath a 110 kV transmission line	2960	2.6
by the fence of the substation, directly beneath a 400 kV transmission line	800	0.89
Beneath OHL 400 kV at the intersection with local road towards Mareza	1170	0.7
400 kV facility	9040	2.11
110 kV facility	6480	3.27

Image 3. SS 400/110 kV Podgorica 2

SS 220/110/35 kV Mojkovac

Measurements of the electric field strength and magnetic induction have been carried out for the assessment of impacts of substations and related overhead lines on SS staff, a business facility "Aluline" and the population residing near the substation. Measurements were taken at 41 measuring point. Based on the results of the measurement the maximum values have been selected and shown in Table V.

Table V

Location	The highest value of the electric field strength measured at location E [V/m]	The highest value of magnetic induction measured at location B [μT]
Access road to a factory "Aluline" and around the factory	1270	1.34
Around the fence of the substation	700	0.99
In 220 kV and 110 kV facility	2825	5.97
220 kV OHL Podgorica 1	1270	1.34
Double-circuit 110 kV OHL Ribarevine and 35 kV Kolašin	716	0.646

Image 4. SS 220/110/35 kV Mojkovac