ELETROMAGNETIC FIELDS AND ENVIROMENTAL NOISE: HUMAN HEALTH IMPACTS IN SERZEDELO, GUIMARÃES (PORTUGAL)

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ABSTRACT

The present paper investigates the risks that arise from exposure to noise from powerpoles and powerlines in Serzedelo, in the municipality of Guimarães, in Portugal. This research focused on four guiding questions: Can powerlines cause noise? Do powerlines cause discomfort? Do powerlines cause discomfort due to noise? And can powerlines effect human health? Two groups were the basis of the study: people that were *exposed* to electromagnetic waves and people that were *not*. The research pointed to the harmful influence of the presence of powerlines and high-voltage masts in residential areas and the damage to the cells in the human body. This type of environmental noise, which has the spectral content of a low frequency, typically tonal noise and a very high speed of propagation, is a complex source to explain in terms of the health profiles of the human population living in Serzedelo, located in an area that is densely occupied by high voltage powerlines and powerpoles.

Keywords: environmental noise, low frequency noise, electromagnetic fields, human health, poles and powerlines.

Introduction

This paper discusses a complex issue that involves the effects of electromagnetic fields and low frequency noise coming from high and very high voltage electrical powerpoles and powerlines in Serzedelo, a municipality of Guimarães, in Portugal. This territory is suffering from important population pressures in Portugal and is intersected by high concentrations of high and very high voltage powerpoles and powerlines. More specifically, there are four powerlines that are 400kv and 9 powerlines that are 150kv.

The process of the production, transmission and use of electricity is associated with the generation of electric, magnetic and electromagnetic fields. In Portugal, the electricity supply comes through a 50Hz frequency current, which is considered to be a high or very high voltage current. This often places the process of the production, transmission and supply of electricity in the range of low frequency. The electric field formed by these powerlines and powerpylons can ionize air molecules and cause a low frequency noise. This ionization occurs in a thin crown of air around the conductors; it is termed the crown or corona effect. This ionized air can be spread by the wind up to a few kilometres away (Sá, 2008). According to Berglund et al. (1996), the low frequency noise is conceptualized as an unpleasant sound containing major components within a specific frequency range (<500 Hz, including infrasound).

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The concept of risk

The classical approach of risks can be distinguished into three phases of epistemological interpretation. The first phase corresponds to the hazard paradigm (Parker, 2000), with a focused vision in nature that prevailed until the 1970s. The second phase considers the anthropic dimension in the process production risk. Finally, the third phase, from 1990, corresponds to an integrated approach to natural hazards and their management, the complexity of causal relationships and the recontextualization risks throughout the social system (Pelling, 2003; Vinet, 2007). The concept of the adopted risk is comprised of the invisible risks from the impact of the exposure to noise from powerpoles and powerlines. In this sense, it is a risk nature built and is comprised of a system of risk that is inserted into a spatio-temporal context, and therefore, is liable to suffer interference from other processes.

LFN and effects in human health

Noise exposure has harmful effects and constitutes a risk factor for human health. Some authors have treated these effects under the names of *vibroacoustic disease* (Castelo Branco; Alves-Pereira, 2004), *vibroacoustic syndrome* or *pathology vibronoise* (Grechkovskaia et al., 1997), and systemic pathology, encompassing the entire organism, characterized by the abnormal proliferation of extra-cellular matrices, caused by excessive and prolonged exposure to low frequency noise (LFN) (Alves-Pereira, 1999; Castelo Branco; Alves-Pereira, 2004).

Since the 1920s, there have studies conducted on the physiological effects of noise on human health arising from different sources (Laird, 1928; Dart, 1946; Rumancev 1961; Cohen, 1976; Grechkovskaia et al., 1997; Balunov et al., 1998; Magomedov et al., 1997; Izmerov et al., 1997). Despite the record number of studies over the past century on the effects of low frequency noise on the impact on human health, there are still no references to LFN from the electromagnetic fields of the powerpoles and powerlines and their corresponding effects on human health. The electric, magnetic and electromagnetic fields are physical agents associated with the use of electricity for the transmission and transportation of energy (low frequency, 60 Hz). These fields interact with living beings, in general, and the human body, in particular, causing harm by inducing electrical currents that exceed the shielding skin, damaging cells and the most sensitive organs (Déoux and Déoux, 1996, WHO, 1998). The noise study focused on the low frequency range below 500Hz, as these are the characteristics of the source.

Materials and methods

The methodology used for the monitoring of the environmental noise was grounded in the document prepared by the Agência Portuguesa do Ambiente (Portuguese Environment Agency) and supported by the company, Redes Energéticas Nacionais (National Energy Networks), titled the *Methodological Guide for Assessing the Environmental Impact of Infrastructure of the National Network of Transmission of Electricity.* The methods adopted and the methodological procedures used are described in *Annex LA 21,* which deals with the parameters monitored in the soundstage.

The methodology described in the document has been alluded to in the Portuguese applicable standards; it has undergone some minor changes. Among these changes are the query to the meteorological data of the Instituto Português do Mar e da Atmosfera (Portuguese Institute of Ocean and Atmosphere), the measurement frequency and the measurement L_{Aeq}.

The measuring points were selected based on the methodology used by Azevedo (2010) about exposure to electromagnetic fields in Serzedelo, Guimarães. This included exposed (e.g. domiciled within 50 meters) and unexposed (e.g. domiciled a distance equal to or greater than 250 meters). A field measurement of LAeq was taken using a sound level meter of class 1 and a tripod. Measurements were performed at two intervals of 10 minutes each, for the first measurement and the second frequency measurement LAeq. The measurements were made on typical days. In each case, the measurement height was 1.5 m; it was carried out away from the facade of the buildings (4 m) and the reflective surfaces.

Discussion and conclusions

Loud noise causes many disturbances in the human system. These include mood changes, irritability and interference with the metabolism in terms of risk of cardiovascular disorders. Sound pressure levels above 65 dB (A) can corroborate to increase the cases of insomnia, stress, irritability and aggressive behavior. Levels above 75 dB (A) can generate problems of hypertension and deafness (Laird, 1928; Dart, 1946; Rumancev 1961; Cohen, 1976; Grechkovskaia et al., 1997; Izmerov et al., 1997; Magomedov et al., 1997; Balunov et al., 1998; Alves-Pereira, 1999; Castelo Branco and Alves-Pereira, 2004). In Serzedelo, 9 points were selected for the measurement of environmental noise. Measurements were performed during three collection activities: June 26, July 3, and July 8, 2014. A spectral analysis was used to verify the spectral composition of the two groups in the analysis. It was performed on the same day of the measurement with the same weather conditions and different terrains (Figure 1).

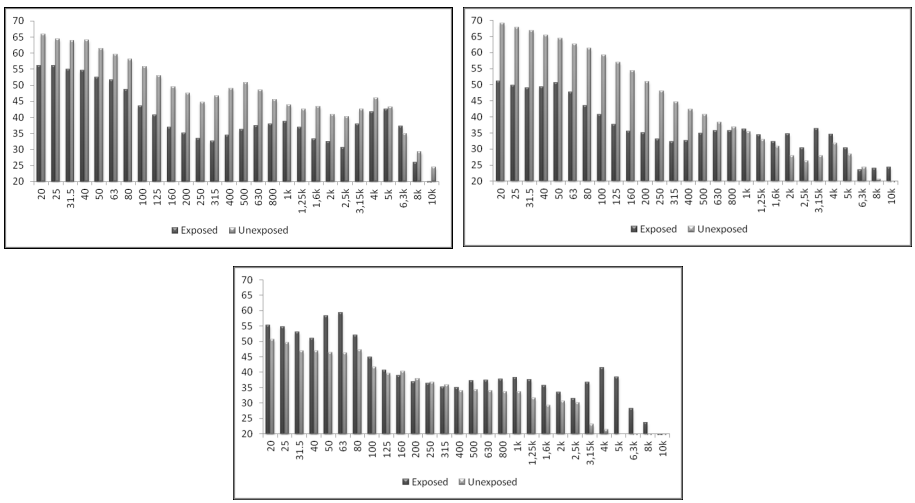

Figure 1: Spectral analysis of the first, second and third block

Although the data presented little distinction about the two groups in the analysis (Azevedo, 2010), some concluding notes were exposed. More specifically, in both of the groups, the analysis of higher intensities was concentrated in the low frequency. This can have two plausible explanations. The first is that noise in the low frequency area is not the exposed group from another source. The second is the need to redefine the radius of the exposed and unexposed

groups. The spectral analysis of the third block distinguishes the features of the previous measurements. The particularity of this analysis is found in high levels in the exposed group in the low frequency and was higher than the unexposed group. In the case of this analysis, it is assumed that the capacity of the high voltage powerpole can reveal significant aspects. For example, the powerpoles with a very high tension of the emitters can be perceived as noise, and as the spectral analysis of the measurement block, display intensities were higher in the low and high frequency in the exposed group and the medium frequency in the unexposed group.

Rescuing the guiding questions, some observations can be drawn: a) Do powerlines of high and extra high voltage cause noise? Yes, powerlines of high and extra high voltage cause low frequency noise; this was observed in the measurements made; b) Do powerlines of high and extra high voltage cause discomfort? A range of studies have reinforced the assertion that the low frequency noise causes harmful effects on human health. The powerlines of high and extra high voltage cause discomfort, as can be seen in two interviews conducted during the activity in situ; c) Do powerlines of high and extra high voltage cause discomfort due to noise? Yes, the sixth measurement enabled us to verify the existence of noticeable noise; testimony from residents was also collected about noise nuisance from the powerpoles; d) Do powerlines of high and extra high voltage cause impacts on human health? A series of studies, including the World Health Organization (WHO), has warned people about the harmful human health effects of exposure to electromagnetic field effects.

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