Reed College Electromagnetic Fields and Electromagnetic Radiation Health Manual

June 2024

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1.0 Purpose and Scope

This manual serves to evaluate the risk of prolonged exposure to various degrees of electromagnetic field and inform all potentially exposed workers as to the potential risks and preventative measures that can be taken in the case that their work brings them into frequent contact with electromagnetic fields.

2.0 Responsibilities of Positions

2.1 Environmental Health and Safety Department (EHS)

The Environmental Health and Safety Department keeps track of high-intensity electromagnetic sources above 4 milligauss on campus, which have been determined to pose a measurable risk with prolonged exposure, such as the laser in the physics building or the reactor. These sources often pose additional risks, which are addressed in several of our other programs (https://www.reed.edu/ehs/safety-information-and-programs/).
For further information, consult especially:

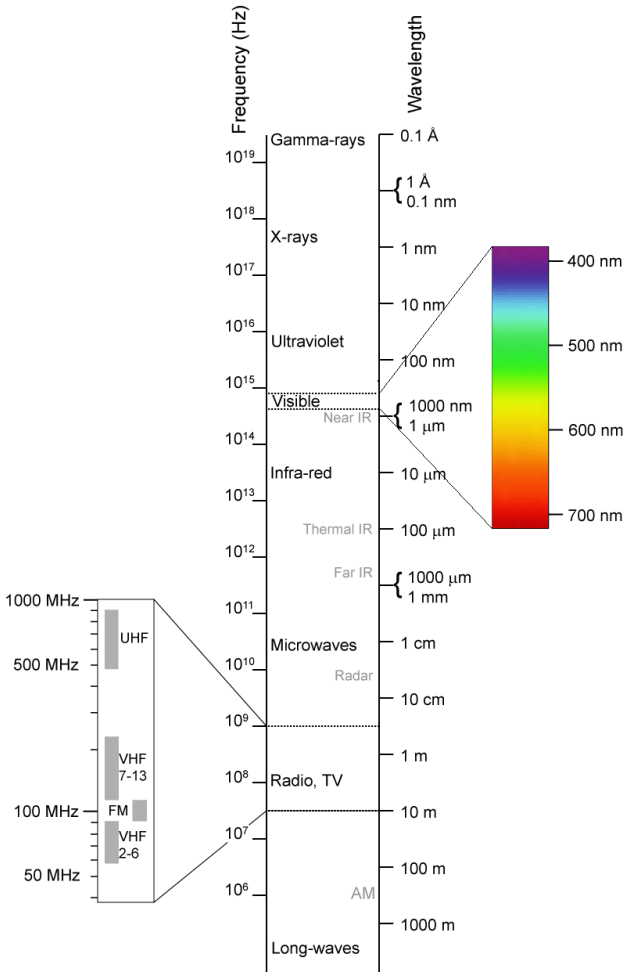
- Laser Safety
  - (https://www.reed.edu/ehs/assets/downloads/safety-information-forms/laser-safety/)
- Radiation Safety Programs
  - (https://www.reed.edu/ehs/radiation_safety/)
- Physics Safety Manual
  - (https://www.reed.edu/ehs/assets/downloads/safety-information-forms/physics-safety-manual.pdf)

Other sources of electromagnetic radiation are not closely monitored by EHS, as they have not been shown to pose significant health and safety risks. Nevertheless, this document contains suggestions and possible safety measures that can be implemented if electromagnetic radiation exposure is a concern.

3.0 Guide to Electromagnetic Radiation

3.1 Electromagnetic Fields

All electromagnetic radiation falls within a specific range, or spectrum, of frequencies. Frequencies are used to measure electromagnetic radiation because the frequency is the main factor that corresponds to the amount of energy that an electromagnetic wave can have. The other factor that influences the energy contained in an electromagnetic wave is the intensity, or amplitude, of the wave. For example, the difference between blue and red light of the same brightness is solely that blue light has a higher frequency. However, both types of light can become brighter and brighter with added amplitude until they are too bright to look at. Visible light of this intensity may be too bright to look at, but it will not damage skin or cause sunburn because the frequency of the light is too low.



Even at high intensities, visible light's frequency is too low to carry enough energy to penetrate skin. The ability of light to penetrate skin is commonly measured by the ability of the light to increase the temperature of tissues. Visible light makes up only a tiny portion of the electromagnetic spectrum, from about 400 trillion to 800 trillion hertz, oscillating at 400 trillion to 800 trillion times per second. Visual light forms the boundary between ionizing and non-ionizing electromagnetic radiation. Ionizing radiation, including ultraviolet (UV), X rays, and gamma rays, can carry enough energy to break apart molecules and directly damage DNA and cells. In contrast, non-ionizing radiation, including visible, infrared, microwave, radio, and extremely low frequency waves, cannot carry enough energy to break chemical bonds or damage cells.

3.2 Extremely Low Frequency Emission Hazards

During the 1990s, most electromagnetic frequency (EMF) research focused on extremely low frequency (ELF) exposures stemming from conventional power sources, such as power lines, electrical substations, or home appliances. While some of these studies showed a possible link between EMF field strength and an increased risk for childhood leukemia, their findings

indicated that such an association was weak. The few studies that have been conducted on adults show no evidence of a link between EMF exposure and adult cancers, such as leukemia, brain cancer, and breast cancer.

Workers may be exposed to low frequency magnetic fields if they work near electrical systems that use large amounts of electric power (for example, large electric motors, generators, or the power supply or electric cables of a building). Magnetic fields of large magnitude are also found near power saws, drills, copy machines, electric pencil sharpeners, and other small electric appliances. The strength of the magnetic field depends on equipment design and current flow, not on equipment size, complexity, or voltage. Though some electric equipment produces EMFs of other frequencies, most health research has considered only frequencies near 60 Hz, the most commonly emitted extremely low frequency.

Studies have shown that some workers exposed to high magnetic fields have increased cancer rates. But such associations do not necessarily show that EMF exposures cause cancer (any more than the springtime association of robins and daffodils shows that one causes the other). Scientists have looked carefully at all the EMF evidence, but they disagree about the health effects of EMFs except to say that better information is needed.

Many studies report small increases in the rate of leukemia or brain cancer in groups of people living or working in high magnetic fields. Other studies have found no such increases. The most important data come from six recent studies of workers wearing EMF monitors to measure magnetic fields. All but one study found significantly higher cancer rates for men with average workday exposures above 4 milligauss (the average clerical worker typically experiences around 1 milligauss, roughly equivalent to the level of background radiation on Earth). However, the results of these studies disagree in important ways such as the type of cancer associated with EMF exposures. So scientists cannot be sure whether the increased risks are caused by EMFs or by other factors.

In 2002, the International Agency for Research on Cancer (IARC), a component of the World Health Organization, appointed an expert Working Group to review all available evidence on static and extremely low frequency electric and magnetic fields. The Working Group classified ELF-EMFs as “possibly carcinogenic to humans,” based on limited evidence from human studies in relation to childhood leukemia. Static electric and magnetic fields and extremely low frequency electric fields were determined “not classifiable as to their carcinogenicity to humans”.

In 2015, the European Commission Scientific Committee on Emerging and Newly Identified Health Risks reviewed electromagnetic fields in general, as well as cell phones in particular. It found that, overall, epidemiologic studies of extremely low frequency fields show an increased risk of childhood leukemia, although no mechanisms have been identified and there is no support from experimental studies that explains these findings. It also found that the epidemiologic studies on radiofrequency exposure do not show an increased risk of brain tumors or other cancers of the head and neck region, although the possibility of an association

with acoustic neuroma (a noncancerous tumor on the nerve running from the inner ear to the brain) remains open.

Tissue heating is the principal mechanism of interaction between radiofrequency energy and the human body. At the frequencies used by mobile phones, most of the energy is absorbed by the skin and other superficial tissues, resulting in negligible temperature rise in the brain or any other organs of the body.

A number of studies have investigated the effects of radiofrequency fields on brain electrical activity, cognitive function, sleep, heart rate and blood pressure in volunteers. To date, research does not suggest any consistent evidence of adverse health effects from exposure to radiofrequency fields at levels below those that cause tissue heating. Further, research has not been able to provide support for a causal relationship between exposure to electromagnetic fields and self-reported symptoms, or “electromagnetic hypersensitivity”.

4.0 EMF Safety Measures

For household appliances and other devices used in the home that require electricity, electromagnetic field levels are highest near the source of the field and decrease rapidly the farther away the user is from the source. Electromagnetic fields drop precipitously at a distance of about 1 foot from most appliances. For computer screens, at a distance of 12–20 inches from the screen that most persons using computers sit, electromagnetic fields are similarly dramatically lower.

The National Institute for Occupational Safety and Health (NIOSH) and other government agencies do not consider EMFs a proven health hazard. Because some studies have associated high magnetic field exposures with increased cancer risks, the government will continue studying EMFs. While research continues, concerned workers and employers might consider the following simple, inexpensive measures for reducing EMF exposures:

- Inform workers and employers about possible hazards of magnetic fields.
- Increase the worker’s distance from the EMF source. Since magnetic fields often drop off dramatically within about 3 feet of the source, workers can stand back from electrical equipment, and workstations can be moved out of the 3-ft range of stronger EMF sources such as induction forges and power lines.
- Use low-EMF designs wherever possible (for the layout of office power supplies, for example).
- Reduce EMF exposure times. No action should be taken to reduce EMF exposure if it increases the risk of a known safety or health hazard such as electrocution.