

MRI SOLUTIONS EXTREMELY LOW FREQUENCY (ELF) DETECTION AND SOLUTIONS



Much of today's technologically advanced medical imaging relies on extremely sensitive electrical detection. Electro-Magnetic Interference (EMI) directly affects many imaging modalities such as MRI, fMRI, nuclear cameras, LINAC, image amplifiers, and other lesser known electrical detection systems. The EMI spectrum ranges from <1 Hz to gamma rays at 1019 Hz. An important sector of detection is that involving human physiology. The EMI spectrum for most living organisms is in the range of 0.5 to 100 Hz, whereas the human bandwidth of interest is 0.5 to upwards of 50 Hz. Primary human electrical detection modalities are:

- Electroencephalography (EEG) or studies of the brain
- Electromyography (EMG) or studies of the skeletal muscles
- Electrophysiology (EP) and Electrocardiography (ECG or EKG) or studies of the heart
- Electronystagmography (ENG) or studies of the eye
- Magnetoencephalography (MEG) magnetic field brain mapping
- Magnetocardiography (MCG), Fetal magnetocardiography (fMCG)
- other electrically related procedures

Detecting human electrical and magnetic signals require the use of extremely sensitive detectors and amplification. Because ELF is such a low frequency it is effectively an electric/magnetic field. Commercial power systems also employ ELF in the form of 50/60Hz power grids. The earth's DC magnetic field can also interfere with the ability to detect and measure weak magnetic fields within the human brain. The ubiquitous nature of both commercial power grids and the earth's magnetic field can easily disrupt and corrupt the data that is being recorded. ETS-Lindgren is the leader in ELF source detection and shielding solutions. The very nature of ELF interference excludes generally accepted shielding solutions that use electrically conductive barrier materials and inductive/capacitive filters. ELF shielding involves more esoteric solutions requiring in depth experience and practical corrective applications which ETS-Lindgren has acquired with over 60 years of EMI detection and shielding.

ELF Interference Detection

ELF radiation is non-ionizing, and as such is generally considered safe for humans. A desirable location for your system is important for both patient access and staff efficiency. Because the human frequency bandwidth is closely aligned with common AC power sources the location of the medical detector can play a very important role in how the power grid could upset verifiable data results. MEG systems are susceptible to the earth's magnetic field which is impossible to avoid. Nearby electrical power equipment

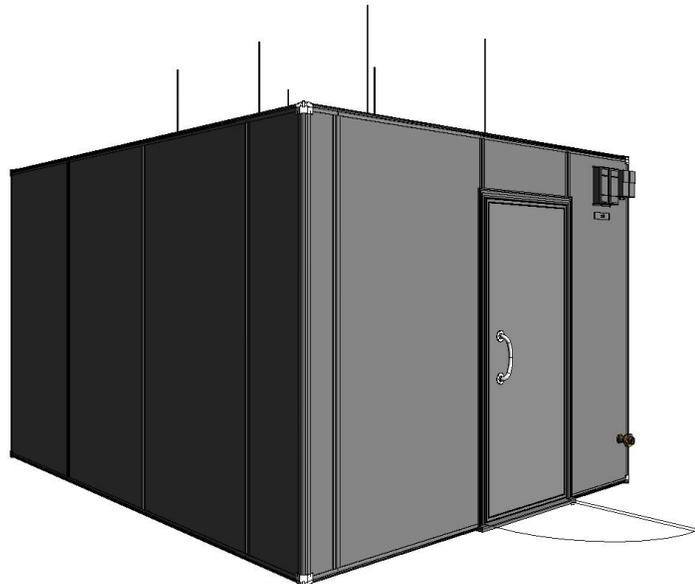
such as motors, power vaults, certain types of lighting as well as moving masses such as elevators are potential sources of ELF interference. ETS-Lindgren has both the technical experience and diagnostic equipment to map your site and identify the source of the interference.

Quantitative Analyses

After site mapping an interference plot is generated and with analyses a practical mitigation solution will be presented to the client.

Shielding Solutions

ELF shielding can be very challenging. One obvious solution is to put distance between the medical device and the source of ELF interference, however in many instances the location is too valuable to give up and relocation may prove to be costly. In those cases, some form of passive shield may be required. ELF is primarily an electric field with a magnetic component; the application of specific materials engineered and constructed into a purpose-built solution can salvage the desirable real estate.



ETS-Lindgren Shielded Room.