Information on Electromagnetic fields at Work.

Introduction

An electromagnetic field is produced whenever electricity is used or transmitted e.g., in televisions, kettles, mobile telephones, magnetic stirrers, security devices, equipment used in diagnostic imaging such as Magnetic Resonance Imaging and radio, television or mobile transmission towers, etc [1].

Large numbers of people are routinely exposed to electromagnetic fields/radiofrequency pulses daily either while undertaking normal activities such as using a mobile phone or by working with equipment that generates magnetic fields or undergoing diagnostic imaging.

Under the Control of Electromagnetic Fields at Work Regulations 2016, equipment can be divided into that which would breach an Action Level (AL) and that which would breach an Exposure Limit Value (ELV). An action level can be measured directly and is generally external to a person's body while an Exposure Limit Value is the direct effect of the electromagnetic field within a person's body and is harder to measure.

Most electromagnetic fields do not have sufficient energy to be categorised as ionising radiation [2].

The fields produced by using electricity can range from being small to large and they can be of several frequencies [3]. The fields can also overlap in terms of their definition:

- Static electric and static magnetic fields 0-1Hz
- Low frequency magnetic and electric fields 1-10MHz
- Intermediate frequency fields 100 kHz - 10MHz
- High frequency fields 100kHz - 300 GHz

Table taken from HSE guidance HSG 281 – A guide to the Control of Electromagnetic Fields at Work Regulation 2016

Field and frequency range	Effects	Examples of activities and equipment
Static electric and static magnetic fields: 0-1 Hz	**Indirect effects:** Uncontrolled attraction of ferromagnetic objects, i.e., the risk of injury from objects in a large static magnetic field being attracted to magnets in the workplace and hitting anyone in the way. **Sensory effects:** Nausea, vertigo, metallic taste in the mouth, flickering sensations (magneto phosphenes) in peripheral vision. **Health effects:** Micro shocks	MRI scanners (main magnet) Electrochemical processes, e.g., industrial electrolysis, aluminium extraction Nuclear magnetic resonance spectrometers Electromagnetic lifting cranes Electric vehicles (cars, underground trains)
Low frequency magnetic and electric fields: 1 Hz-10 MHz	**Indirect effects**: Interference with active or passive implanted or body-worn medical devices, electric shocks, causing electro-explosive devices to initiate, i.e., when used in close proximity to explosives that have an electrical means of initiation. Sparks caused by induced fields triggering fires or explosions where flammable fuels, vapours or gases are present. **Sensory effects:** Nausea, vertigo, metallic taste in the mouth, flickering sensations (magneto phosphenes). **Health effects**: Nerve stimulation, effects on the central and peripheral nervous system of the body: tingling, muscle contraction, heart arrhythmia. Contact currents caused by a person touching a conductive object in an EMF where one of	High voltage power lines Production and distribution of Electricity Welding (arc and spot) Electrical arc furnaces Industrial induction heating (e.g. large coils used around the site of a weld) AM radio Electric hand-held tools Electric vehicles (cars, trains,

	them is grounded and the other is not, which can result in shocks or burns.	trams, metros) Magnetic resonance imaging (MRI Switched Field gradients)
Intermediate frequency fields:100 kHz–10 MHz	The health effects of both high and low frequencies can be experienced as detailed above and below.	Surgical diathermy Broadcasting systems and devices (AM radio) Anti-theft devices Military and research radiofrequency systems
High frequency fields: 100 kHz–300 GHz	**Indirect effects**: Interference with active or passive implanted or body-worn medical devices, electric shocks, causing electro-explosive devices to initiate, i.e. when used in close proximity to explosives that have an electrical means of initiation. Sparks caused by induced fields triggering fires or explosions where flammable fuels, vapours or gases are present. **Sensory effects:** Auditory effects such as perception of clicks or buzzing caused by pulsed radar systems. **Health effects**: Thermal stress, heating effects leading to a rise in core body temperature or localised limb heating (eg knees or ankles) Contact with charged conducting bodies can lead to RF shock or deep tissue burns.	MRI (RF coils) Broadcasting and TV antennas Radar and radio transmitters Diathermy Dielectric heating (e.g. vulcanising, plastics welding or microwave drying) Anti-theft systems

Medical devices that could be affected by Magnetic Fields

Implantable medical devices can be categorised into two types[4].

Passive devices: hip, knee, joints, contraceptive Intra-Uterine Devices
Active medical devices: *Which rely on a power source for their function*.
These include implanted medical devices such as cardiac pacemakers, implantable cardioverter-defibrillator, implantable neurostimulators, deep brain stimulator electrodes, spiral cord stimulators, implantable infusion pumps, cochlear implant systems, retinal implants, insulin pumps, etc.

The above is not an exhaustive list as new devices are being produced by research institutions and industry every year.

Possible effects of Electromagnetic Fields

Depending on the electromagnetic field/radiofrequency pulses produced and the length of time of exposure and the energy of the field they may cause direct physical effects in humans such as heating of tissues, or the induction of muscle or sensory activity[5].

Indirect effects that electromagnetic fields/radiofrequency pulses may cause interactions with active implanted medical devices. It is unlikely that people will be exposed to a field of sufficient strength to generate heating in passive medical devices while working in a laboratory. Microwaves are electromagnetic radiation [6] but are not normally regarded as being an electromagnetic field as produced by a magnetic stirrer.

As people may be exposed to electromagnetic fields while working in a lab, it is important to be aware of which equipment could generate an electromagnetic field. These could be magnetic stirrers, some stirrers only have rotating electric fields rather than physical magnets, there other types of lab equipment which could include/induce magnetic fields are Peltier Thermoelectric Coolers or heaters.

The electromagnetic fields generated within the offices and laboratories of the university are unlikely to cause direct or indirect heating or other health effects.

Types and Location of High Voltage systems within SGUL

Unlike many universities that have engineering and / or physics departments where high voltages, high currents and high energy electromagnetic fields are used, SGUL has a limited amount of equipment that falls in this category.

Hunter Wing 3rd Floor 11kV High Voltage Substation

Hunter Wing Roof Plantroom Main Low Voltage Switchgear

Hunter Wing All Floors LOW VOLTAGE Electrical Risers located next to Staircases.

Jenner Wing Basement 11kV HIGH VOLTAGE Substation.

Jenner Wing Roof 11kV HIGH VOLTAGE Substations.

Jenner Wing LOW VOLTAGE Electrical Risers located next to Staircases.

D Block 11 kV HIGH VOLTAGE Substation located on Perimeter Road.

J Block Standby Generators.

F-Block Basement – Main LOW VOLTAGE Switchgear.

F-Block - All Floors LOW VOLTAGE Electrical Risers located next to Staircases.

Horton Halls – Ground Floor Main LOW VOLTAGE Switchgear

Horton Halls - All Floors LOW VOLTAGE Electrical Risers located next to Staircases.

General Safety precautions.

Under the Control of Electromagnetic Fields at Work Regulations 2016 employers need to consider any risks arising from exposure to electromagnetic fields (EMFs)[3, 8].

This includes expectant mothers and workers who have declared the use of active implanted medical devices (AIMDs), passive implanted medical devices (PIMDs) or body-worn medical devices (BWMDs). The main risk to pregnant women within SGUL will be the use of MRI units. The use of these units should always be authorised with the instrument manager. The usage should be noted in the user's pregnancy risk assessment.

Most of the laboratory equipment used in biomedical research does not produce radiofrequency pulses or electromagnetic fields that could induce electrical currents which could cause heating or the stimulation of implanted devices.

Individuals who may need to use high power devices and have an active implantable medical device should check the equipment manual. Some equipment may have the following symbols or similar signs if they pose a hazard.

When working in a laboratory, it is always good practice to operate the equipment at arm's length if possible. This reduces the exposure as magnetic field strength decreases as distance[6] increases, similar to ionising and non-ionising radiation.

The magnetic fields produced by the stirrers used in labs are unlikely to cause problems.

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