Local Rule:
Control of Non-Ionising Radiation

1. Potential Health Effects from Non-Ionising Radiation

Non-ionising radiation (NIR) is the term used to describe the part of the electromagnetic spectrum covering two main regions, namely optical radiation (ultraviolet, visible and infrared) and electromagnetic fields (power frequencies, microwaves and radio frequencies).

The University undertakes many research activities which involve NIR sources. Examples include laser research and development, ultraviolet equipment (e.g. trans illuminators), furnaces and nuclear magnetic resonance (NMR) sources. The consequences of poor management of such sources can result in potential exposure to NIR and lead to a health effect.

Figure 1: Electromagnetic spectrum

Over exposure to optical sources of NIR can cause biological damage, mainly to the eyes and skin. Potential damage is dependent on numerous factors relating primarily to the source of NIR and the environment it is used in.

Exposure of the eyes to ultraviolet radiation can damage the cornea and produce pain and symptoms similar to that of sand in the eye. The effects on the skin range from redness, burning and accelerated ageing through to various types of skin cancer.

High-power lasers can cause serious damage to the eye (including blindness) as well as producing skin burns if misused or accidents occur.

Artificial Optical Radiation (AOR) exposure limit values (ELV) are highly dependent on the part of the optical spectrum under consideration. The biological effects of AOR on the skin and eyes are closely related to the wavelength of the optical source. Variation is particularly significant for the eyes where the wavelength determines the level of penetration and therefore the severity of the hazard.

Exposure of people to high levels of Electromagnetic Frequencies (EMF) can give rise to acute effects. The effects that can occur depend on the frequency of the radiation. At low frequencies the effects will be on the central nervous system of the body whilst at high frequencies, heating effects can occur leading to a rise in body temperature. In reality, these effects are extremely rare and will not occur in most day-to-day work situations.

Table 1: Possible effects of wavelengths on the eyes and skin

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Eye</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 – 280</td>
<td>UVC</td>
<td>Photokeratitis</td>
</tr>
<tr>
<td>280 – 315</td>
<td>UVB</td>
<td>Photokeratitis</td>
</tr>
<tr>
<td>315 – 400</td>
<td>UVA</td>
<td>Photokeratitis</td>
</tr>
<tr>
<td>380 – 780</td>
<td>Visible</td>
<td>Photokeratitis</td>
</tr>
<tr>
<td>780 – 1400</td>
<td>IRB</td>
<td>Cataracts</td>
</tr>
<tr>
<td>1400 – 3000</td>
<td></td>
<td>Skin cancer</td>
</tr>
<tr>
<td>3000 – 10^11</td>
<td>IRC</td>
<td>Corneal burn</td>
</tr>
</tbody>
</table>

It should also be noted that certain activities involving NIR may have the potential to produce ionising radiation e.g. x-rays, activation of materials and the production of radioactive isotopes. There is a Local Rule which deals with Ionising Radiation, however, if there is any doubt, please contact Safety Services.
The University aims to manage its risks from non-ionising radiation by complying with the Control of Artificial Optical Radiation at Work Regulations 2010 (CAORW10) and the Management of Health and Safety at Work Regulations, 1999 (MHSW99).

Further legislation is expected in the UK in 2013, aimed at the protection of workers who may be exposed to electromagnetic fields. This is based upon the European Union Physical Agents Directive (Electromagnetic Fields: 2004/40/EC).

2. **Key Definitions**

- **Artificial Optical Radiation (AOR)** – means any electromagnetic radiation in the wavelength range between 100nm and 1mm which is emitted by non-natural sources.

- **As Low As Reasonably Practicable (ALARP)** – means ensuring risks from non-ionising radiation are kept to a minimum.

- **Controlled Area** – means an area where the activities within are subject to control and supervision for the purpose of laser radiation hazard protection.

- **Dept. Radiation Protection Supervisor (DRPS)** – a person appointed in writing, in a functional role to assist the Head of Department in the management and supervision of ionising and non-ionising radiation activities. Note: different DRPSs can be appointed for particular NIR sources/activities and this can vary within departments, for example, DRPS (Lasers).

- **Exposure Limit Values (ELV)** – limits on exposure which are based on established health effects and biological considerations. Compliance with the limits should protect workers against known adverse health effects.

- **Local Rule (LR)** – means a written document which summarises the arrangements for controlling work with non-ionising radiations. This LR outlines the key requirements and management actions for controlling work with non-ionising radiations across the University. Departments may also require additional LR to include departmental arrangements and contingency plans for any reasonably foreseeable accidents and incidents.

- **Radiation Protection Adviser (RPA)** – a qualified expert, recognised as being suitable, competent, knowledgeable and experienced in the field of radiation protection.

3. **Exposure Limit Values**

Exposure Limit Values (ELV) and guidelines have been developed based on the recommendations of the International Commission of Non-Ionising Radiation Protection (ICNIRP). The University works to these. These take into account, and assess potential biological effects by considering biological variables, such as the actual mechanisms of injury, the reversibility of damage, the effect of normal biological responses (e.g. normal eye movements). Thus the impact of ELVs varies with the range of frequencies, wavelengths (source intensity) and exposure duration. Protection against exposure to NIR sources is through the risk assessment process.

3.1. **Optical Radiation ELVs**

For non-coherent optical radiation and laser radiation, ELVs are specified respectively within Annexes I and II of European Union Physical Agents Directive (Optical Radiation: 2006/25/EC) and as referenced to within the CAORW10 Regulations.

3.2. **Electromagnetic ELVs**

Future EMF exposure limit values are expected to be based upon existing guidelines and ELVs provided by the ICNIRP. Legislation on workers’ exposure to electromagnetic fields is expected in the UK in 2013. This is based upon the European Union Physical Agents Directive (Electromagnetic Fields: 2004/40/EC).
4. **Assessing the Risks from Non-Ionising Radiation**

4.1. **Identifying the hazards**
Departments must identify all work activities, equipment and location which may present a non-ionising radiation exposure risk to staff, students and others. For all such activities and equipment sources, a risk assessment must be carried out to assess and then control any identified risks. This requires that each senior research manager responsible for the work activities must take responsibility for the completion of the required risk assessments.

**Figure 2:** Initial process to identify AOR risks

1. **Do you use sources of Artificial Optical Radiation (AOR)?**
   - **No action required**
   - **Yes**
2. **Do you use hazardous sources of AOR that could harm workers?**
   - **No action required**
   - **Yes**
   - **This is a legal requirement and you need to take action**
3. **Do you have adequate controls in place to manage the risks?**
   - **No**
   - **Yes**
   - **Make sure you have recorded action and informed staff**

**Source:** HSE: Guidance for employers AOR Regulations 2010

Background information required for the risk assessment process should include the following:
- types of non-ionising sources involved (including power, wavelength, duration of exposure etc.);
- potential exposures (generally for high risk sources), that could possibly exceed ELVs and may require additional controls and health surveillance;
- manufacturer’s advice on safe use and maintenance;
- engineering control measures and design features in place or planned;
- any planned safe systems of work;
- effectiveness and suitability of personal protective equipment to be provided;
- likelihood and potential severity of possible accident situations;
- consequences of possible failures of control measures;
- measures implemented to prevent identified accident / incident situation, or to limit their consequences;
- contingency and emergency arrangements; and
- hazards in addition to the non-ionising ones should be considered. For example, laser risk assessments should consider both beam and non-beam hazards.

Any particular health conditions or situations which could increase the risks to staff and students should also be considered within the risk assessment. Examples include:
- pre-existing medical conditions made worse by light;
- use of chemicals such as skin creams which could react with light to make health effects worse;
- staff and students who may be exposed to multiple sources of light at the same time; and
- situations in which exposure could present unrelated risks (e.g. temporary blindness if exposed to bright light).

4.2. **Evaluating Non-Ionising Radiation Risks**

Working with Safety Services, the University RPA can advise on risk assessments, measurements and calculations, control measures, working practices and arrangements for restricting exposure to ionising radiations and ensuring legal compliance with both CAORW10 and MHSWR99.
4.3. Deciding on and Implementing Risk Control Measures

Where Departments have identified hazardous sources of non-ionising radiation which present a “reasonably foreseeable” risk of harming the eyes and/or skin of staff and students, they must implement measures to reduce this risk as low as reasonably practicable (ALARP).

Departments must seek ways of reducing the risk of exposure to non-ionising radiation, by considering the following hierarchy of controls:

- **elimination** – does the non-ionising radiation source need to be used in the first place?
- **substitution** – can an alternative, safer source (e.g. of light) achieve the same result?
- **engineering** – this is the main way of reducing exposure to non-ionising radiation. The main types of engineering controls include the use of filters, screens, enclosures, protective housings, shutters, key and password access controls for equipment, emergency stop controls, remote viewing, specialist curtains, safety interlock systems, clamping of work pieces, dedicated room, remote controls and time delays;
- **administrative** – use of safe systems of work/standard operating procedures, training of workers, organisation of work schedules and use of warning signage; and
- **personal protective equipment** – issue of appropriate and suitable clothing, goggles, eyewear and face shields where applicable.

Figure 3: Hierarchy of control measures

A regular inspection of departmental locations and auditing of radiation safety management arrangements will be normally be undertaken by Safety Services and the RPA. Departments will also monitor the effectiveness of their own arrangements on a regular basis.

4.4. Recording the Significant Findings

The significant findings of the risk assessment process must be recorded and include the following:

- the activities/equipment assessed;
- the risk of exposure to non-ionising radiation and who could be affected;
- the control measures already in place to manage the risk;
- the relevant information, instruction and training to be provided to staff and students;
- the details of any health surveillance in use or planned; and
- the action plan of additional controls to reduce the risk.

The risk assessment will need to be reviewed if there is any reason to suspect that the original assessment is no longer valid or there has been a significant change in the work to which the assessment relates. In any case the risk assessment should be reviewed on a regular basis.

5. Providing Information, Instruction, Training and Supervision (IITS)

The requirement for information, instruction, training and supervision applies to all people who could be exposed to non-ionising radiation. However, different categories of people (for example, DRPSs, laser workers, managers, cleaning and maintenance staff etc.) will require different levels of IITS depending on their activities, the levels of risk involved, their past training and their roles.

IITS should be appropriate to the nature of the work and the needs of the individual and in most cases will consist of core training, along with departmental training in arrangements and procedures.
Non-ionising workers will need to be aware of:

- the main risks to them, including accidental exposure risks;
- control measures to prevent or minimise the risks;
- contingency plans and what to do in an emergency;
- where to obtain further help and advice; and
- when to contact the DRPS/Safety Services/RPA etc.

A record of all training provided should be maintained and where necessary refresher training undertaken.

6. **Arranging Health Surveillance**

Health surveillance may be required in circumstances where the risk of adverse health effects to the skin has been identified from the risk assessment; as a result of an ELV being exceeded or following an accident or incident (e.g. laser eye strike).

7. **Further Information and Guidance**

Publications free to download on the Health and Safety Executive and other websites:

**General**

- [HSE Non-ionising radiation](https://www.hse.gov.uk/radiation/nonionising.htm)
- [Health Protection Agency - Non-ionising radiation](https://www.hpa.org.uk/Topics/WorkplaceHealth/NonionisingRadiation/)
- [International Commission on Non-ionizing Radiation Protection (ICNIRP) (www.icnirp.de/)](https://www.icnirp.de/)

**Association University Radiation Protection Officers Guidance Notes**

- [AURPO Guidance Note No. 7: Guidance on the safe use of lasers in education and research: 2012 Edition](https://www.aurpo.org/)

**Various Publications and guidelines on Optical and EMF radiation**

- [Health and Safety Executive website (non-ionising radiation index)](https://www.hse.gov.uk/radiation/nonionising.htm)
- [European Committee for Electrotechnical Standardization (CENELEC)](https://www.cenelec.eu/)
- [International Electrotechnical Commission (IEC)](https://www.iec.ch/)
- [European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry (COCIR)](https://www.cocir.org/)
- [Health Protection Agency - Various information sheets on non-ionising radiation](https://www.hpa.org.uk/Topics/WorkplaceHealth/NonionisingRadiation/)
- [International Commission on Illumination (ICE): Division 6: Photobiology and Photochemistry](https://www.ice-division6.org/)
- [Buying new machinery INDG271](https://www.hse.gov.uk/indg271.htm)

**Lasers**

- British Standard EN 207: 1999. Filters and Equipment used for Personal Eye-Protection Against Laser Radiation
- Health Protection Agency - FAQs about lasers.
External exposure in relation to Outside Workers

- Working in the sun
- Sun Protection
- Keep your top on: Health risks from working in the sun INDG147
- Sun protection: advice for employers of outdoor workers INDG337
- SunSmart: the UK’s national skin cancer prevention campaign

Electromagnetic Radiation

- Health Protection Agency - FAQs about Electromagnetic Fields
- ICNIRP Guidelines and downloadable documents
- National grid information site on EMFs: www.emfs.info

University of Strathclyde

- Safety Services’ Forms
Current legislation (MHSWR99 and CAORWR10) places specific management responsibilities and requirements on all work places utilising non-ionising radiation sources and equipment. Implementation of this Local Rule will be monitored as part of Safety Services Audit Programme, therefore, Heads of Department or equivalent must ensure the following points are implemented where non-ionising radiation risks are present in a department.

The following summarises how departments can effectively implement this Local Rule and integrate it into its management systems. These processes will be monitored as part of Safety Services’ Audit Programme, and where departments are able to demonstrate fulfilment of key actions, this is likely to provide strong evidence of good practice.

<table>
<thead>
<tr>
<th>Key Management Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Departmental Roles</strong></td>
</tr>
<tr>
<td>Heads of Department must ensure:</td>
</tr>
<tr>
<td>- Suitable and appropriate numbers of trained DRPS's are appointed in writing (RP2 Form) to help ensure compliance with non-ionising legislation, University procedures and for the supervision of arrangements set out in departmental safety arrangements and local rules. This should take account of the nature, range, complexity and locations of the non-ionising radiation work;</td>
</tr>
<tr>
<td>- Sufficient resources and managerial support is provided to allow DRPSs to operate effectively;</td>
</tr>
<tr>
<td>- Any notifications and/or investigations (e.g. accident) are carried out when requested (or as appropriate) and in line with any specified time period;</td>
</tr>
<tr>
<td>- Appropriate health and safety management arrangements are put in place and implemented (where applicable) for the various aspects relating to non-ionising radiation work (see points below) and that these arrangements are regularly reviewed and updated where and when necessary;</td>
</tr>
<tr>
<td>- Recommendations issued by the RPA/Safety Services following safety audit visits or if advised outwith are acted and implemented on as soon as possible; and</td>
</tr>
<tr>
<td>- A register/list of all non-ionising radiation workers is maintained by the Department.</td>
</tr>
<tr>
<td><strong>2. Identifying hazards</strong></td>
</tr>
<tr>
<td>Departments must ensure procedures and arrangements are in place:</td>
</tr>
<tr>
<td>- Identifying work activities and equipment sources which may present a non-ionising radiation risk;</td>
</tr>
<tr>
<td>- Ensuring no high risk non-ionising radiation sources or equipment is brought into or removed from departmental or University premises without appropriate notification/authorisation with the DRPS; and</td>
</tr>
<tr>
<td>- Maintaining an up-to-date inventory of non-ionising radiation-sources and equipment which can be provided to Safety Services when requested.</td>
</tr>
</tbody>
</table>
### Key Management Actions (Contd.)

<table>
<thead>
<tr>
<th>3. Evaluating risks</th>
<th>Departments must ensure procedures and arrangements are in place for ensuring:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- All high risks areas and locations are suitably identified and appropriately designated (if required);</td>
</tr>
<tr>
<td></td>
<td>- Local Rules are available for any areas designated as Laser Controlled Areas;</td>
</tr>
<tr>
<td></td>
<td>- Consulting occurs with Safety Services and RPA on all new proposed non-ionising radiation facilities, locations, projects or activities which may require advice on design features and engineering controls;</td>
</tr>
<tr>
<td></td>
<td>- Consultation and additional advice is sought where necessary from the RPA, Occupational Health and Safety Services;</td>
</tr>
<tr>
<td></td>
<td>- All lasers and laser containing equipment (except class 1) are appropriately identified by their class;</td>
</tr>
<tr>
<td></td>
<td>- Where new or second-hand NIR equipment is being brought into the department, that it meets acceptable standards in terms of labelling and safety controls; and</td>
</tr>
<tr>
<td></td>
<td>- Any NIR sources being built as prototypes or being modified/adapted meet acceptable standards in terms of labelling and safety control.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Implementing Risk Control Measures</th>
<th>Departments must ensure:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- a risk assessment is undertaken, prior to starting work and that it is regularly reviewed or reviewed if significant changes occur;</td>
</tr>
<tr>
<td></td>
<td>- laser risk assessments consider both beam and non-beam hazards and</td>
</tr>
<tr>
<td></td>
<td>- risk assessments are reviewed regularly or when significant changes have occurred.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Management procedures and arrangements</th>
<th>Departments must ensure procedures and arrangements are in place for ensuring:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- High risk non-ionising radiation sources/equipment, are maintained in good condition and that regular testing and checking of engineering controls, design features, safety features and warning devices are carried out and documented;</td>
</tr>
<tr>
<td></td>
<td>- Suitable and appropriate personal protective equipment is provided (e.g. laser protective eyewear) where deemed necessary from the risk assessment and ensure it is used and stored correctly and that arrangements are in place for the regular maintenance and examination of such equipment;</td>
</tr>
</tbody>
</table>
| 5. | **Management procedures and arrangements (Contd.)** | - Suitable and appropriate arrangements are in place for maintenance and security staff, visitors, non-ionising radiation workers going to visit other establishments or coming from other establishments and for contractors and servicing engineers in terms of access to areas, risk assessments, induction and training; and  
- Health surveillance (via Occupational Health Service) if the risk assessment indicates that adverse health effects to the skin are likely or that ELV’s are likely to be exceeded. |

| 6. | **Information, instruction, supervision and training** | Departments must ensure procedures and arrangements are in place for ensuring:  
- DRPSs receive appropriate and suitable training, time and support for their roles as DRPS;  
- All non-ionising radiation workers are provided with relevant information, instruction, supervision and training in relation to the risks and work activities involving non-ionising radiation and  

A record with the details of the training provided to non-ionising radiation workers is retained. |