THE UNIVERSITY of EDINBURGH
Health & Safety Department

RP GN 101 – Artificial Optical Radiation Risk Assessment Guidance

VERSION CONTROL	
Document Author:	Mark Green
Date of Creation:	April 2021
Date of Revision and Initials of Reviewer:	N/A
Date of next review (if required):	April 2023
Document Reference Number:	HS / RP / GN101.1

Table of Contents

Lasers and broadband optical sources

1 Introduction

Before any work is carried out with artificial optical radiation (AOR) sources at the University of Edinburgh, a suitable and sufficient risk assessment must be completed. AOR includes laser and broadband optical sources (e.g. UV sources, LEDs etc). **No work with potentially hazardous AOR sources is to be conducted until this risk assessment has been carried out.** Guidance on potentially hazardous AOR sources is given in Part 2 of the University of Edinburgh non-ionising radiation (NIR) Code of Practice:

https://www.ed.ac.uk/health-safety/radiation-protection/codes-of-practice-and-guidance/codes-of-practice

It is the duty of the Principle Investigator, Manager or person responsible for a project/piece of equipment, to carry out the risk assessment. This Guidance Note (GN) provides guidance on carrying out risk assessments for AOR sources. For further assistance, contact your Departmental Laser Supervisor (DLS). A list of all University DLSs can be found here (EASE Login required):

https://www.ed.ac.uk/health-safety/radiation-protection/supervisors

Under the Control of Artificial Optical Radiation at Work Regulations 2010 (AOR10) and the Management of Health and Safety at Work Regulations 1999 (MHSWR99), the University must ensure a suitable and sufficient risk assessment is in place for all work with potentially hazardous AOR sources. This risk assessment should consider both the AOR hazards, as well as any non-AOR hazards (e.g. fume, chemicals etc).

The classification of a laser or the risk group of a broadband optical source gives a good indication of the risk presented by the optical radiation (i.e. the laser beam) emitted by that source. A summary of the classification and risk group schemes is given in Appendix A of this GN. The most significant risks are presented by Class 3B and 4 lasers, and Risk Group 3 broadband optical sources.

Section 2 of this GN provides guidance on carrying out risk assessments. As described in the University's Non-ionising Radiation Code of Practice, the University expects that control measures are implemented in accordance with the Hierarchy of Control Measures (Figure 1), where the most effective or reliable controls, or the controls with the largest impact are implemented first, rather than choosing the easiest control measure to implement.

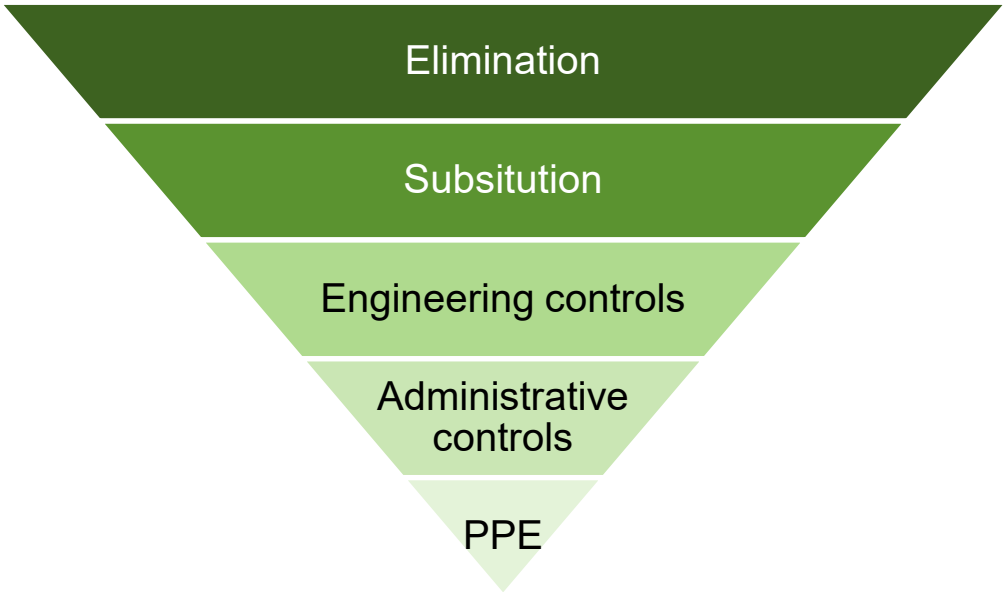


Figure 1. Hierarchy of Control Measures.

It is appreciated that in some situations, control measures lower down the hierarchy are necessary (e.g. laser protective eyewear for some laser beam alignment procedures). While the University does not prohibit this work, it regards this type of work to be the exception rather than the norm and is only permitted if a robust justification has been made supporting the case against using control measures further up the Hierarchy (i.e. justifying why it is not reasonably practicable to enclose a laser beam).

It is **never acceptable** for personal protective equipment (e.g. laser protective eyewear) to be chosen as a control measure before consideration is given to the hierarchy of control measures.

To assist University staff in carrying out AOR risk assessments, the University has produced templates, as follows:

Appendix B – risk assessment template for Class 3B and 4 lasers.

Appendix C – risk assessment template for Class 1, 1M, 1C, 2, 2M and 3R lasers.

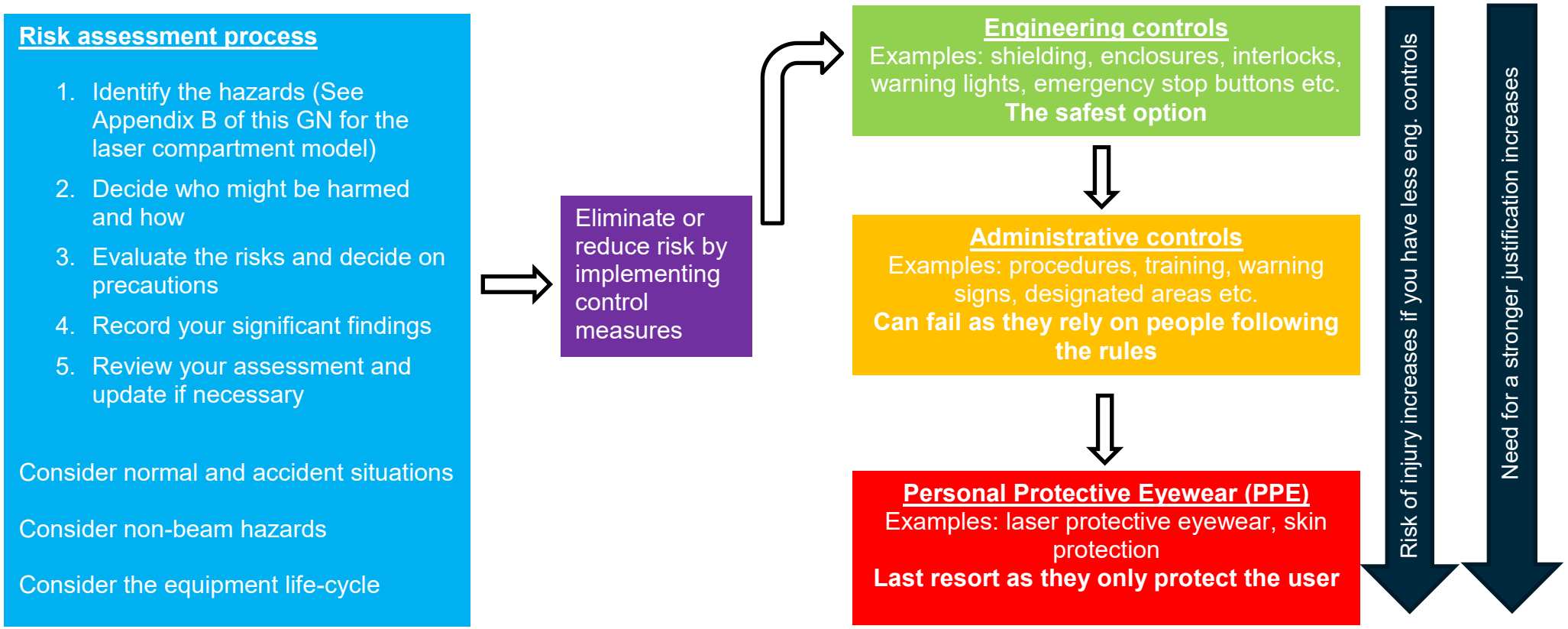
Appendix D – risk assessment template for broadband AOR sources.

The templates, and example risk assessments for some commonly used applications (e.g. Laser cutters, 3D laser printers, Confocal microscopes, etc), can be found here:

https://www.edweb.ed.ac.uk/health-safety/radiation-protection/radiation-protection-management/risk-assessments-nir

2 Process for carrying out risk assessment and selection of appropriate control measures

A risk assessment is simply a careful examination of what, in your work, could cause harm to people, so that you can weigh up whether you have taken enough precautions or should do more to prevent harm. When determining the control measures required to make the work safe, it is a legal requirement that the University follows the 'hierarchy of control measures', which places an emphasis on good equipment design and engineering controls before considering administrative controls (e.g. safe working procedures, training, warning signs) and personal protective equipment (laser protective eyewear). The flow chart below provides guidance on the process for carrying out risk assessment and the selection of appropriate control measures. Further guidance on control measures is given in Section 3 of this GN.



3 Implementation of control measures

This section of the GN provides guidance on the implementation of control measures for AOR sources. The control measures listed in this section is not exhaustive, but the most common have been included. If there is any doubt about the suitability of a control measure, contact the Departmental Laser Supervisor (DLS) or the University Radiation Protection Adviser (RPA).

3.1 Engineering Controls

Control measure	Description
Engineering controls – when determining control measures, priority should be given to engineering control measures as they offer the greatest level of protection.	
Guarding and enclosures	The use of guarding and enclosures to prevent access to AOR is an effective way of preventing exposure to AOR. The enclosure/guarding needs to be constructed from appropriate material, be robust, secure and appropriate for the intended use. For lasers, the risk assessment should identify the risk of the beam striking the guarding and if this is reasonably foreseeable, the material must be able to withstand that exposure for as long as required. Enclosures/guarding must have a sufficient optical density and must also be robust enough to withstand other environmental issues such as mechanical impact. For high power lasers such as those used for materials processing, enclosures/ guarding must also be able to withstand penetration through burning or ablation etc. See the British Standard '*Safety of Laser Products – Part 4: Laser Guards (BS EN 60825-4)',* which specifies the requirements for laser guards. For all protective enclosures the means of preventing unintended or unauthorised access to the AOR is an important consideration. Ideally the enclosure will be securely fixed in place with any access panels interlocked to the operation of the AOR source. If this is not possible, (e.g. routine access is required) further administrative controls (see the 'administrative controls' section below) and PPE may be required. The guarding must be properly labelled. For lasers, the requirement for labelling is specified in the British Standard *Safety of Laser Products – Part 1: Equipment Classification and Requirements (BS EN 60825-1)'.* (See 'administrative controls' section below).

Control measure	Description
Interlocks	Where there is a reasonably foreseeable risk of serious injury due to accidental opening of an access panel, it is recommended that the panel is interlocked to the operation of the laser. This means that opening the panel would shut off the AOR. In some cases, it may be necessary to interlock the door to a laser room/laboratory, or area where work with hazardous AOR is being carried out. This should not be required if the AOR source has been made safe using engineering control measures. **Door interlocks can only be justified if it is not possible to properly enclose the AOR source.** If door interlocks are necessary further administrative controls, including the designation of a Laser or AOR Controlled area (see the 'administrative controls' section below) and PPE are likely to be required to protect those people working in the area. Door interlocks may be 'non-locking interlocks' which shut off the AOR source when the door is opened or 'locking interlocks', which prevent the door being opened when the AOR source is in use. Other issues (such as access to rooms in an emergency), must be considered when this type of system is used. All interlock systems must be robust, not easily defeated and should fail to safety. If the interlock system has an override facility (e.g. for servicing), it should not be possible for the interlock to remain overridden after this work has been carried out. This requirement can be achieved, for example, by limiting the duration of override operation or by mechanical design of the override mechanism. There should be a distinct warning whenever the interlock override is in operation.
Viewing windows or remote viewing	If it is necessary to view a laser/AOR process, viewing windows can be installed in an enclosure. The material of the viewing window would depend on the laser/AOR type and output. Evidence from the supplier of the window must be obtained to show that the window is suitable for use with the AOR source. It may also be possible to view the laser process using a CMOS/CCD camera. This is often cheaper and easier than installing a viewing window.

Control measure	Description
Remote adjusters	Where optics etc. need to be manipulated, devices can be utilised that allow the user to perform adjustments from outside the enclosure, without the need to breech it. It is recommended that this is considered when designing a new laser system. Remote adjusters may only be required on the most frequently adjusted components with those components requiring less frequent adjustment remaining behind locked panels.
Warning lights	Automatic warning lights are useful for indicating when an AOR hazard is present. These lights automatically illuminate when hazardous AOR emissions are initiated (e.g. laser shutter open). They are especially useful outside a laser or AOR controlled area to indicate to persons outside the area that a hazard exists. A warning light may incorporate symbols and text to explain its meaning, however if not, it should be accompanied by a sign to explain the meaning of the light. Class 3R laser systems with wavelengths below 400 nm and above 700 nm and Class 3B and Class 4 lasers must incorporate a warning device that gives an audible or visible signal when the laser system is switched. This device should fail to safety.
Emergency stop buttons	Depending on the outcome of the risk assessment, it may be necessary to install emergency-stop buttons to terminate hazardous AOR emission in the event of an incident/emergency. E.g. emergency stop buttons may be installed in a Laser or AOR Controlled Area so that the beam can be quickly terminated, in the case of an incident/emergency. This should be considered in relation to other risks in the area. Emergency stop buttons must be appropriately labelled.
Key control	Class 3B and 4 lasers must have a key control, which prevents emission of the laser radiation when the key is removed. This key control does not need to be a physical key, but may be another device to prevent unauthorised use, such as a password to be entered into the operating software. As far as reasonably practicable, if the laser or AOR source has a key control, the key should be removed from the equipment and kept securely when the equipment is not in use. In situations where the laser or AOR source must be left switched on for long periods of time (and left potentially unattended), due to the nature of the work being carried out, there must be adequate control measures put in place to prevent unauthorised access to the hazardous beam.

3.2 Administrative Controls

Control measure	Description
Administrative controls – Access to hazardous AOR should be prevented by engineering means as far as is reasonably practicable. Where this cannot be fully achieved, administrative controls should be employed, with the aim of preventing access to hazardous AOR. This should be done in conjunction with barriers, side panels, beam tubes, and partial enclosures, where possible.	
Laser/AOR Controlled Area	In areas where there could be access to hazardous levels of AOR (e.g. above the Exposure Limit Values (ELVs) specified by AOR10), a Laser or AOR Controlled Area should be designated. This area should be clearly delineated (ideally it should be a designated room), and access limited to authorised individuals who have received adequate training. There must be no escape of hazardous AOR from a Laser or AOR Controlled Area. Warning signs (e.g. AOR or laser hazard), prohibition signs (e.g. no entry) and mandatory signs (e.g. laser protective eyewear), as appropriate, must be clearly displayed outside the Laser/AOR Controlled Area. These signs must be compliant with the Health and Safety (Safety Signs and Signals) Regulations. Measures must be put in place to prevent unauthorised persons accessing Laser/AOR Controlled Areas and the hazardous AOR. These measures must be determined by the risk assessment and may include: - Interlocked doors (see the 'engineering controls' section above) - Warning lights (see the 'engineering controls' section above) - Laser safe covers for windows - Warning/prohibition signs By its nature, a Laser/AOR Controlled Area will require procedures to be followed by individuals working within the area, to ensure their safety. These procedures should be documented in a 'Local Procedural Controls' document. Guidance on writing a Local Procedural Controls document can be found in RP GN 102 "*Laser Procedural Controls Guidance*". Individuals working in laser or AOR controlled areas must be provided with appropriate PPE (see 'PPE section' below).
Laser beam path	The beam path must be kept within the expected bounds of the experiment, i.e. the equipment should include beam stops to terminate

Control measure	Description
	the beam at the end of its useful path. It is good practice to keep the beam on the same horizontal plane, and that plane should not be at eye level (standing or seated). Periscopes should be avoided if possible, but if they are used, they must be fully enclosed, to avoid open vertical beams. Beam stops/shutters/attenuators should be available for use in the case of an emergency beam termination.
Laser labels	Apart from Class 1 lasers, all other laser products must be labelled in accordance with British Standard *Safety of Laser Products – Part 1: Equipment Classification and Requirements (BS EN 60825-1)*. The presence of appropriate labelling should be checked during the risk assessment process. Where additional guarding, enclosures or panels are added, these should also be labelled in accordance with the above Standard. Guidance on laser labelling and marking can be found in Radiation Protection Guidance Note RP GN 103 "*Laser Labelling and Marking*".
Local Procedural Controls	All Laser and AOR Controlled Areas, and any area that requires procedures to be followed to prevent harm when working with sources of AOR, must have a Local Procedural Controls document in place. The Local Procedural Controls document must be specific to that particular area. If an area contains more than one hazardous AOR source, e.g. a laser laboratory, or a manufacturing workshop, there should be one Local Procedural Controls document for that area. The Local Procedural Controls document must follow the template given in RP GN 102 "*Laser Procedural Controls Guidance*". All users must declare that they have read and agree to work in accordance with the Local Procedural Controls document for the area.
Training	All users of potentially hazardous AOR and laser equipment (as identified by the risk assessment) must receive appropriate training. This would include the University 'Basic Laser Safety Training' in addition to any local training required, as identified by the PI, Manager or person responsible for the work. For hazardous tasks, such as laser beam alignment, training covering how to carry out the task safely **must** be carried out. Refresher training must also be provided at suitable intervals. Usually a suitable refresher training interval will be every three years, but it

Control measure	Description
	depends on the work being conducted and the findings of the risk assessment. Records of training must be maintained.

3.3 Personal Protective Equipment

Control measure	Description
Personal Protective Equipment (PPE) – these controls are the last resort when engineering and administrative controls alone cannot adequately reduce the risk of exposure. It is not acceptable to rely on PPE before full consideration has been given to the implementation of control measures further up the hierarchy.	
Laser protective eyewear	Where there is access to laser radiation in access of the ELVs, those in the area should be provided with laser protective eyewear. This eyewear must conform to the British Standards BS EN 207 or BS EN 208, and should display appropriate markings on the filter or frame to indicate what type of laser it is suitable for. The PI, Manager or person responsible for the work must ensure that the laser protective eyewear is appropriate for the laser(s) being worked with. If the eyewear is not rated for the laser in question, it may not offer the required protection. Further guidance on laser eyewear can be found in Radiation Protection Guidance Note RP GN 104 "*Laser Safety Eyewear*".
Laser protective clothing	Where primary and reflected beams of the laser are accessible and of sufficient power to cause damage to the skin suitable protective clothing must be worn. **This must be an exception. In the vast majority of cases laser protective clothing should not be required as there should be no access to lasers that could cause damage to the skin.**
PPE for Ultraviolet (UV) sources	Where there are accessible sources of UV radiation (e.g. UV transilluminators), PPE will be required to protect the eyes and the skin. They may include protective eyewear, face shields, and gloves. This PPE must be suitable for use with UV sources and there must be demonstrable evidence of this e.g. PPE manufacturer's safety information or markings on the PPE.

Appendix A - Summary of classification schemes

Figures 2 and 3 below summarise the laser classification scheme (as defined in BS EN 60825-1: 2014) and the risk group scheme for broadband optical sources (as described in BS EN 62471: 2008). See Part 2 of the NIR policy for more information about lasers and broadband optical sources.

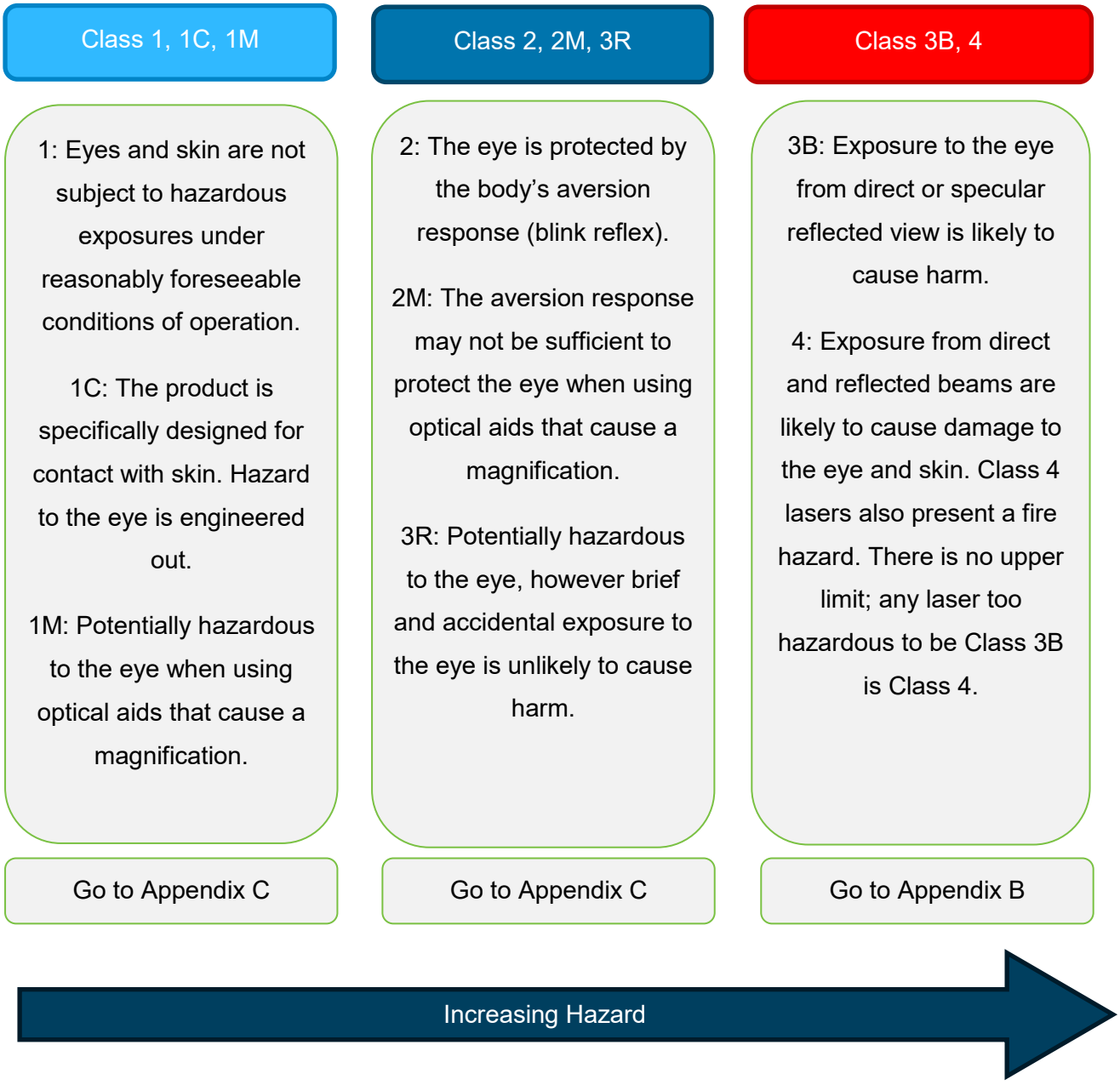


Figure 2. Summary of the laser classification system

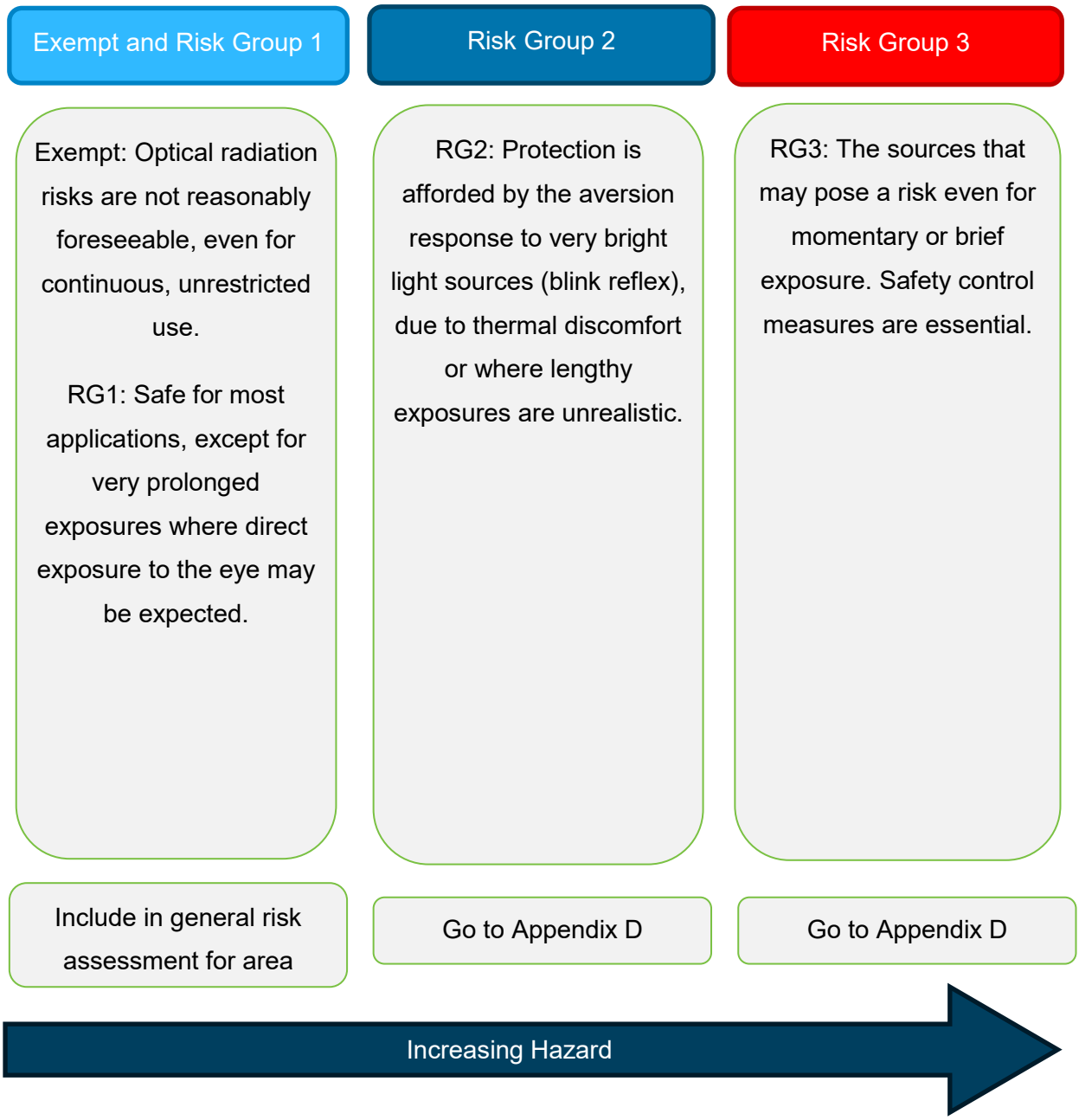


Figure 3. Summary of the broadband source (lamp) classification system

Appendix B - Risk assessment template for Class 3B and 4 lasers

This document, once completed and approved, constitutes a laser risk assessment for the work to which it relates. A laser risk assessment should be completed for each laser application at the University before work first begins and when there are any significant changes to the work.

This Risk Assessment is required to ensure that all work with hazardous lasers is carried out safely. In addition, it will help to ensure that the requirements of The Control of Artificial Optical Radiation at Work Regulations 2010 (AOR10) and The Management of Health and Safety at Work Regulations 1999 (MHSWR99) are met.

Even though the University has formalised a process for carrying out laser risk assessments, the onus is still on the Principle Investigator (PI), Manager or Supervisor to demonstrate they have identified all the hazards and assessed the risks for their work. Laser risk assessments must be reviewed periodically or when an experiment significantly changes.

University Campus, School and Building		**Date of Risk Assessment**	
Room/Area where work activity will be carried out		**Risk Assessment Ref. No.:**	
Scope of Risk Assessment			

	Name	**Title**	**Signature**	**Date**	**Date of next review**
Author					
Reviewer & Approver		**Departmental Laser Supervisor (DLS)**			

Table 1 – Description of laser application

Table 1 – Description of laser application						
Description & Classification of laser(s) covered by this risk assessment.						
	Laser 1	Laser 2	Laser 3	Laser 4	Laser 5	Laser 6
Laser name and manufacturer						
Laser beam wavelength (or range)						
Type of laser (e.g. He:Ne, CO_2)						
Output (e.g. pulsed, continuous)						
Laser power or energy						
Pulse length and pulse repetition frequency						
Laser classification						
	For additional lasers, please append an extra sheet to this risk assessment.					
Location of laser application						
Part of 'Life cycle' covered	Routine use ☐	Installation ☐	Maintenance ☐	Alignment ☐	Testing ☐	
	Other ☐ (Please Specify)					

Table 1 – Description of laser application	
Persons who may be affected by the use of this equipment. *Things to consider (list not exhaustive):* • *Those working with the equipment* • *Others who may be in the area when the equipment is being used.* • *Those in the area but not connected with the work.* • *Visitors/students* • *Cleaners or maintenance staff*	
Could additional hazards arise during other parts of the life cycle?	
Is a risk assessment in place for other parts of the equipment life cycle?	

Beam path diagram

If applicable, insert a beam-path diagram in the space below.

Laser compartment model

Laser applications will have hazards associated with the beam itself, as well as non-beam hazards (e.g. high voltages, fumes, high temperatures, chemicals etc), which can often be more hazardous that the laser beam. This risk assessment must consider both the laser beam and the non-beam hazards. A systematic approach to identifying all the hazards is to use the compartment model, which splits an application into four compartments, as follows:

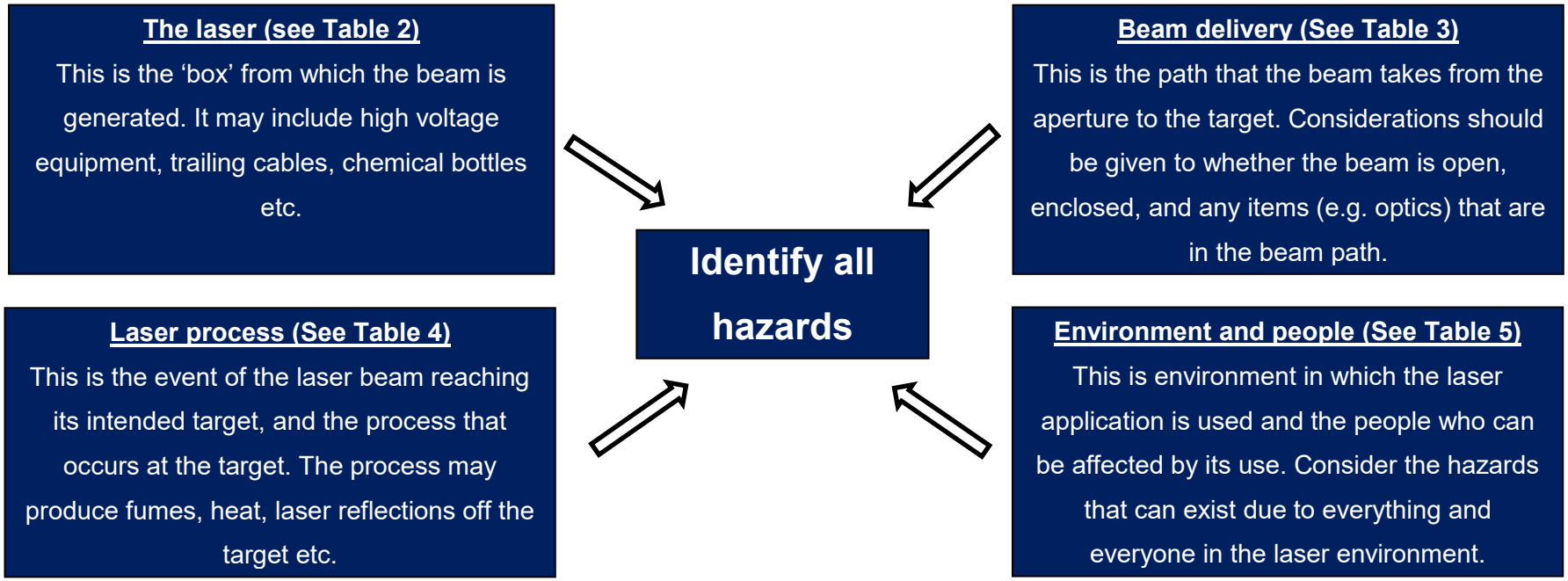


Table 2: The laser

Table 2: The Laser		
DETAIL	**DESCRIPTION**	**HAZARDS**
Describe the laser(s) and **identify** the hazards. *Things to consider (list not exhaustive):* • *How is the laser controlled? E.g. key/ software.* • *Security arrangements for the physical key or software access/password?* • *Is a beam shutter fitted: what triggers the shutter, how does lasing re-start if a shutter is actuated?* • *Is a remote door interlock fitted to the laser? Does this fail to safety?* • *Are interlocks good quality or easy to defeat simple spring/reed switches?* • *Is there an interlock override function?* • *Does the laser incorporate an emission warning indicator?* • *How does the laser interface with any active safety system – warning lights, door interlocks?* • *Would the laser still produce a laser beam if door interlocks and or warning lights were accidentally disconnected?* • *How is beam power increased/decreased?* • *How are power levels verified?* • *Are correct warning labels on the laser and all panels?*		High voltage ☐ Yes Gas cylinders ☐ Yes Toxic gases/chemicals ☐ Yes Mechanical ☐ Yes Noise ☐ Yes Trailing cables ☐ Yes Fire/explosion ☐ Yes Cryogenic fluids ☐ Yes Other hazards ☐ Yes (Describe below)

Table 3: The beam delivery

Table 3: Beam Delivery		
DETAIL	**DESCRIPTION**	**HAZARDS**
Describe the beam delivery and identify the hazards. *Things to consider (list not exhaustive):* • *Open or partially open beam?* • *Fully enclosed and interlocked?* • *Fibre delivery?* • *Robustness of enclosure?* • *Optical components in beam?* • *How is adjustment carried out?* • *What percentage of the beam path is enclosed?* • *Termination of beams?*		Open or partially open beam ☐ Yes (See table 7 below) Objects in beam ☐ Yes Reflective surfaces present ☐ Yes Beam alignment carried out ☐ Yes Variable beam path ☐ Yes Potential for fibre damage ☐ Yes Beam initially out of alignment ☐ Yes Other hazards (specify) ☐ Yes
Could the Maximum Permissible Exposure (MPE) be exceeded?	☐ Yes ☐ No	
What is the nominal ocular hazard distance (NOHD) of the beam?		

The University has purchased a site license of the Laser Safety software LaserBee for assisting those carrying out AEL, MPE, NOHD, etc. calculations. It can also assist users in selecting the appropriate eyewear to EN 207 and EN 208.

To download a copy of LaserBee to your PC, contact your DLS or the University RPU Team: radiation@ed.ac.uk

Table 4. The laser process

Table 4: The Laser Process		
DETAIL	**DESCRIPTION**	**HAZARDS**
Describe the laser process (e.g. what is the beam doing when it interacts with the target?) • *Does the laser interaction produce additional hazards: fire, explosion, heating, other optical radiation?* • *Is fume produced (cutting operations?) If so, is there fume extraction fitted?* • *Alignment of beam and target if required how is this carried out?* • *Is the interaction contained to protect against secondary hazards? If so, consider containment failure consequences.* • *Is the target presence sensed/detected could the laser beam be fired without a target present? If so, what are the consequences?*		Laser fume ☐ Yes Scatter from target ☐ Yes Heating of target ☐ Yes Manual handling of target ☐ Yes Other hazards ☐ Yes (Describe below)

Table 5. The laser environment

Table 5: The laser environment		
DETAIL	**DESCRIPTION**	**HAZARDS**
Describe the environment in which the laser is used. *Things to consider (list not exhaustive):* • *When the laser is in use does the room need be to access controlled to protect individuals or, is there no laser hazard to room occupants?* • *Is there a need to designate the room as a Laser Controlled Area? (See guidance in Section 3 of this GN)* • *Can you secure all access doors to prevent unauthorised access (e.g. are the doors locked with keycard or keycode access or are doors interlocked to the operation of the laser)?* • *Is there adequate heat removal, ventilation, water cooling?* • *If water cooling is used are quality plumbing fittings employed and is the plumbing and equipment positioning chosen to minimise the potential for electrical issues arising from a leakage of coolant?* • *Who will be permitted to be in the room when laser is active?* • *Will persons within the room be required to wear personal protective eyewear?*		Dedicated laser room ☐ Yes Windows in the laser room ☐ Yes Multiple doors into laser room ☐ Yes Reflective objects present ☐ Yes Unrestricted access ☐ Yes Ignition hazards ☐ Yes Out-of-hours access ☐ Yes Other hazards ☐ Yes (Describe below)

Table 6 – Laser risk assessment

Table 6 constitutes the main part of the laser risk assessment, where the risks from the hazards identified in the tables above are evaluated and the need for further control measures determined. Each compartment should be assessed separately for both the beam and non-beam hazards identified in Tables 2 to 5. The hierarchy of control measures must be considered when determining the control measures required.

HAZARDS	**PERSONS AT RISK**	**EXISTING CONTROLS**	**RISK WITH EXISTING CONTROLS** (LOW, MEDIUM, HIGH)	**FURTHER CONTROLS REQUIRED**	**PLANNED DATE FOR IMPLEMENTATION**
The laser (consider the hazards identified in Table 2)					
Beam delivery (consider the hazards identified in Table 3)					

HAZARDS	**PERSONS AT RISK**	**EXISTING CONTROLS**	**RISK WITH EXISTING CONTROLS** (LOW, MEDIUM, HIGH)	**FURTHER CONTROLS REQUIRED**	**PLANNED DATE FOR IMPLEMENTATION**
Laser process (consider the hazards identified in Table 4)					
Environment and people (consider the hazards identified in Table 5)					

Table 7 - Justification of open beam work

Ideally, lasers of classification 3B and 4 should be fully enclosed with access panels interlocked to prevent access to the beam. Reliance must not be placed upon the wearing laser protective eyewear, **unless absolutely unavoidable**. If you are working with an open Class 3B or Class 4 laser beam (i.e. for beam alignment), this will need to be justified and you need to show that you have considered the hierarchy of control measures. Table 7 below must be completed for any open beam work.

Table 7 – Justification of open beam work	
Are you working with a Class 3B or 4 laser that is not fully enclosed with access panels interlocked? *(If yes, please complete the sections below)*	☐ Yes ☐ No
Have you considered the hierarchy of control measures? *(If no, you must consider the hierarchy before commencing with the laser work)*	☐ Yes ☐ No
Is there a specific beam alignment procedure in the Local Procedural Controls Document?	☐ Yes ☐ No
What type of laser protective eyewear is required? State: ✓ The type (D, I, R or M), protection factor (LB number) and wavelength range(s); ✓ How you have selected this eyewear to ensure it offers the required protection; ✓ How the eyewear is used and stored.	
You must provide a justification for not being able to fully enclose the beam and prevent access. This justification must show that you have considered the options and that it is not practicable to implement these controls for your laser application. **Stating that you have trained operators who are familiar with lasers as your only justification is not acceptable.**	Justification Statement:

Appendix C - Risk assessment template for Class 1, 1M, 1C, 2, 2M or 3R lasers

This document, once completed and approved, constitutes a laser risk assessment for the work to which it relates. A laser risk assessment should be completed for each laser application at the University before work first begins and when there are any significant changes to the work.

This Risk Assessment is required to ensure that all work with hazardous lasers is carried out safely. In addition, it will help to ensure that the requirements of The Control of Artificial Optical Radiation at Work Regulations 2010 (AOR10) and The Management of Health and Safety at Work Regulations 1999 (MHSWR99) are met.

Even though the University has formalised a process for carrying out laser risk assessments, the onus is still on the Principle Investigator (PI), Manager or Supervisor to demonstrate they have identified all the hazards and assessed the risks for their work. Laser risk assessments must be reviewed periodically or when an experiment significantly changes.

University Campus, School and Building		**Date of Risk Assessment**	
Room/Area where work activity will be carried out		**Risk Assessment Ref. No.:**	
Scope of Risk Assessment			

	Name	Title	Signature	Date	Date of next review
Author					
Reviewer & Approver		**Departmental Laser Supervisor (DLS) [if one is appointed] or School Safety Advisor**			

Table 1 – Description of laser application

Table 1 – Description of laser application						
Description & Classification of laser(s) covered by this risk assessment.						
	Laser 1	Laser 2	Laser 3	Laser 4	Laser 5	Laser 6
Laser name and manufacturer						
Laser beam wavelength (or range)						
Type of laser (e.g. He:Ne, CO_2)						
Output (e.g. pulsed, continuous)						
Laser power or energy						
Pulse length and pulse repetition frequency						
Laser classification						
	For additional lasers, please append an extra sheet to this risk assessment.					
Location of laser application						
Part of 'Life cycle' covered	Routine use ☐	Installation ☐	Maintenance ☐	Alignment ☐	Testing ☐	
	Other ☐ (Please Specify)					

Table 1 – Description of laser application	
Persons who may be affected by the use of this equipment. *Things to consider (list not exhaustive):* • *Those working with the equipment* • *Others who may be in the area when the equipment is being used.* • *Those in the area but not connected with the work.* • *Visitors/students* • *Cleaners or maintenance staff*	
Could additional hazards arise during other parts of the life cycle?	
Is a risk assessment in place for other parts of the equipment life cycle?	

Table 2 – Laser risk assessment

Summary of laser hazards:

- Class 1 lasers do not pose a hazard during normal operation.
- Class 1M lasers are safe to the eye under reasonably foreseeable conditions of operation, but may be hazardous if magnifying optics are placed within the beam.
- Class 1C lasers are safe to the eye, but may present a hazard to the skin.
- Class 2 lasers are safe to the eye for momentary exposures. Class 2 laser products are not inherently safe for the eyes, but protection is afforded by natural aversion responses to bright light, including the blink reflex.
- Class 2M lasers are safe to the naked eye for momentary exposures into the beam (eye protection is normally afforded by a person's aversion response to bright light), but may be hazardous if magnifying optics are placed within the beam.
- Class 3R lasers are potentially hazardous to the eye but the risk of injury is low for short, unintentional exposures.

Table 2: Laser Risk Assessment				
Question		**Answer**		**Risk assessor comments/references**
2.1	**Does the laser product contain an embedded Class 3B or 4 laser?**	☐ Yes ☐ No	If NO go to 2.4	
2.2	**Are there circumstances where the higher class laser beam could be accessible? (e.g. during servicing, maintenance or alignment?)**	☐ Yes ☐ No	If YES, a risk assessment for Class 3B and 4 lasers (Appendix B) must be completed for this activity. Include a reference to this risk assessment in column 4 of this table. If YES, (but only by an external service engineer), the University must obtain and review copies of the service engineer's risk assessment and method	

Table 2: Laser Risk Assessment				
Question		**Answer**		**Risk assessor comments/references**
			statement for this work, and ensure it is suitable and sufficient. The DLS should normally be involved in checking the service engineer's risk assessment and method statement. A 'Transfer of Control' form must be completed (see local procedural controls document). Confirm the arrangements in column 4 of this table.	
2.3	**Are engineering control measures (e.g. guarding, interlocks etc.) in place to prevent access to the beam?**	☐ Yes ☐ No	If YES, periodic checks on the operation of the safety systems must be carried out and recorded. Confirm the arrangements in column 4 of this table. If NO, explain how access to the beam is prevented.	
2.4	**Are there non-beam hazards associated with this equipment? (e.g. fire, fume, chemical etc)?**	☐ Yes ☐ No	If YES, list these hazards and complete Table 4 to evaluate the risk from these hazards.	
2.5	**For Class 1M or 2M lasers, is it reasonably foreseeable that magnifying optics (e.g. telescopes, binoculars) could be inserted into**	☐ Yes ☐ No	If YES, additional control measures are required. List additional control measures that will be implemented in column 4 of this table.	

Table 2: Laser Risk Assessment				
Question		**Answer**		**Risk assessor comments/references**
	the beam? (Accidental viewing with magnifying optics must be considered, particularly if the laser is used outdoors.)			
2.6	**Is the laser being used as a laser pointer?**	☐ Yes ☐ No	If YES, review Radiation Protection Code of Practice RP GN 110 "*Safe use of Laser Pointers and similar devices*". Only Class 1 or 2 lasers are permitted to be used as laser pointers. Confirm this is the case in column 4 of this table.	
2.7	**Is this laser being used in an area which is open to the public or which is accessible to persons unconnected with the work?**	☐ Yes ☐ No	If YES, describe how persons are protected from exposure to the beam, including from the risks of dazzle/distraction.	
2.8	**Is the equipment labelled with the appropriate information / explanatory labels for its Class?**	☐ Yes ☐ No	If NO, contact the DLS for advice on further actions.	
2.9	**Are any of the lasers classified as Class 3R?**	☐ Yes ☐ No	If YES, also complete Table 3.	

Table 3 – Laser risk assessment (Class 3R laser)

Table 3: Laser Risk Assessment (Class 3R laser)				
Question		**Answer**		**Risk assessor comments/references**
3.1	**Is the laser beam accessible? (e.g. during normal use, alignment, set-up, etc.)**	☐ Yes ☐ No	If NO, list the control measures in place to prevent access to the beam in column 4 of this table. If YES, go to 3.2.	
3.2	**What is the justification for working with this open laser beam(s)?**			
3.3	**What is the output of the beam in comparison with the Maximum Permissible Exposure (MPE) value?**			
3.4	**What is the nominal ocular hazard distance (NOHD) of the beam?**			
The University has purchased a site license of the Laser Safety software LaserBee for assisting those carrying out AEL, MPE, NOHD, etc. calculations. It can also assist users in selecting the appropriate eyewear to EN 207 and EN 208. **To download a copy of LaserBee to your PC, contact your DLS or the University RPU Team: radiation@ed.ac.uk**				
3.5	**If the laser beam has a wavelength below 400 nm or above 700 nm, does it have an emission indicator to show that the laser is on?**	☐ Yes ☐ No	If NO, contact the DLS, as Class 3R lasers with a wavelength below 400 nm or above 700 nm must have an emission indicator.	

Table 3: Laser Risk Assessment (Class 3R laser)				
Question		**Answer**		**Risk assessor comments/references**
3.6	**Is laser protective eyewear provided?**	☐ Yes ☐ No	If NO, explain why in column 4 of this table. If YES, go to 3.7.	
3.7	**What type of laser protective eyewear is required?** *State:* ✓ The type (D, I, R or M), protection factor (LB number) and wavelength range(s); ✓ How you have selected this eyewear to ensure it offers the required protection; ✓ How the eyewear is used and stored.			
3.8	**Have laser users attended the University laser safety training course, as well as specific training on the laser system?**	☐ Yes ☐ No	If YES, ensure training details are recorded. If NO, the users must stop work until they have undertaken appropriate training. Contact the DLS for details.	
3.9	**What measures do you have in place to ensure this laser is used safely?**	List any further measures required.		

Table 4 – Non-beam hazards

Table 4: non-beam hazards					
NON-BEAM HAZARDS	**PERSONS AT RISK**	**EXISTING CONTROLS**	**RISK WITH EXISTING CONTROLS** (LOW, MEDIUM, HIGH)	**FURTHER CONTROLS REQUIRED**	**PLANNED DATE FOR IMPLEMENTATION**

Appendix D - Risk assessment template for broadband AOR sources

This document, once completed and approved, constitutes an AOR risk assessment for the work to which it relates. An AOR risk assessment should be completed for each AOR application with the potential to exceed the Exposure Limit Values (ELVs) at the University before work first begins and when there are any significant changes to the work. (See Appendix C in Part 2 of the NIR CoP for guidance on potentially hazardous AOR sources).

This risk assessment should be completed for all Risk Group 2 & 3 sources, however, it is unlikely that work with AOR sources that are classified as Risk Group 2 and below could result in exposures that exceed the ELVs, unless intentional viewing of the AOR source is carried out. The Risk Assessment is required to ensure that all work with hazardous AOR sources is carried out safely. In addition, it will help to ensure that the requirements of The Control of Artificial Optical Radiation at Work Regulations 2010 (AOR10) & The Management of Health and Safety at Work Regulations 1999 (MHSWR99) are met.

Even though the University has formalised a process for carrying out AOR risk assessments, the onus is still on the Principle Investigator (PI), Manager or Supervisor to demonstrate they have identified all the hazards and assessed the risks for their work. AOR risk assessments must be reviewed periodically or when an experiment significantly changes.

University Campus, School and Building		**Date of Risk Assessment**	
Room/Area where work activity will be carried out		**Risk Assessment Ref. No.:**	
Scope of Risk Assessment			

	Name	Title	Signature	Date	Date of next review
Author					
Reviewer & Approver		**Departmental Laser Supervisor (DLS) [if one is appointed] or School Safety Advisor**			

Table 1 – Description of AOR application

Table 1: Description of AOR application					
DETAIL	**INFORMATION**				
Description of AOR sources covered by this risk assessment **The Risk Group of an AOR source should be provided by the supplier of the source. More guidance is given in Part 2 of the University's NIR CoP.*	Description of AOR source set up:				
	Wavelength range:				
	Risk Group* (if known):				
	Output of source (e.g. W/m^2 at 20cm):				
Part of 'Life cycle' covered	Routine use ☐	Installation ☐	Maintenance ☐	Alignment ☐	Testing ☐
	Other ☐ (Please Specify)				
Persons who may be affected by the use of this equipment. *Things to consider (list not exhaustive):* • *Those working with the equipment* • *Others who may be in the area when the equipment is being used.* • *Those in the area but not connected with the work.* • *Visitors/students* • *Cleaners or maintenance staff*					

Table 2 – AOR risk assessment

Table 2: AOR Risk Assessment				
Questions		**Answer**		**Risk assessor comments**
2.1	**Could the ELV be exceeded around this source in any circumstances (including during servicing etc)?**	☐ Yes ☐ No	If NO, go to 2.11	
2.2	**Provide details of the distance from the source where the ELV could be exceeded and the exposure time before the ELV is exceeded.**			
2.3	**Is the AOR source accessible during normal use?**	☐ Yes ☐ No	If YES, go to 2.5	
2.4	**Are there circumstances where the AOR source could be accessible? (e.g. during servicing or maintenance?)**	☐ Yes ☐ No	If YES, an AOR risk assessment must be in place to cover this. Include a reference in column 4 of this table. If YES, (but only by an external service engineer), the University must obtain copies of the risk assessment and method statement for this work, and ensure it is suitable and sufficient. A 'Transfer of Control' form must be completed (see local procedures document). Include details in column 4 of this table.	

Table 2: AOR Risk Assessment				
Questions		**Answer**		**Risk assessor comments**
2.5	**Are engineering control measures (e.g. guarding, interlocks etc.) in place to prevent access to the source?**	☐ Yes ☐ No	If YES, periodic checks on the operation of the safety systems must be carried out and recorded. Confirm this is being done in column 4 of this table. If NO, explain how access to the AOR source is prevented.	
2.6	**Is this source being used in an area that is open to the public or accessible to persons unconnected with the work?**	☐ Yes ☐ No	If YES, describe how persons are protected from exposure to the AOR source.	
2.7	**Is personal protective equipment (PPE) required?**	☐ Yes ☐ No	If NO go to 2.9	
2.8	**State how you have selected this PPE to ensure it offers the required protection. Explain how the PPE is used and stored.**			
2.9	**Have users been trained in the safe use of the equipment, and are records available?**	☐ Yes ☐ No	If YES, please provide details in Column 4. If NO, work should stop until training has been provided.	

Table 2: AOR Risk Assessment				
Questions		**Answer**		**Risk assessor comments**
2.10	**What measures do you have in place to ensure this AOR source is used safely?**			
2.11	**Are there non-AOR hazards associated with this equipment? (e.g. heat, chemical etc)?**	☐ Yes ☐ No	If YES, list these hazards and complete Table 3 to evaluate the risk from these hazards.	
2.12	**Could this source be a risk to photosensitive individuals?**	☐ Yes ☐ No	If YES, explain what measures you have in place to protect photosensitive individuals.	

Table 3 – Non-beam hazards

NON-BEAM HAZARDS	PERSONS AT RISK	EXISTING CONTROLS	RISK WITH EXISTING CONTROLS (LOW, MEDIUM, HIGH)	FURTHER CONTROLS REQUIRED	PLANNED DATE FOR IMPLEMENTATION