8. Relevance of the Risk Assessment Methodology to Other Laser Industries

8.1 Introduction

The research work has concentrated on developing a risk assessment methodology for the use of lasers in the entertainment industry. However, lasers are used in many other applications. Consideration is given in this chapter to how the methodology could be adapted to a number of other laser industries.

It has already been recognised (Tyrer *et al* 1994) that the generic three-component hazard identification model consisting of the laser application, delivery system and laser, could be applied to any application of laser technology. However, the detail of the hazard identification model used here, the consideration of the risks, and the presentation of the conclusions have been specific to the entertainment industry. Research, medical and industrial applications will be considered in this chapter.

There are many parallels in other industries. Each will have a life cycle, compartments of the application and zones of people at risk. The entertainment industry issues focused down on to whether the audience were exposed to the laser radiation, either by design or under reasonably foreseeable conditions. A similar methodical approach can be used to identify where the key risk issues lie in any laser application. However, a major difference is likely to be the lack of external audit and a much smaller number of people at risk.

8.2 Research

Research, by its nature, often involves the development of laser products which may not have the same level of engineered safety systems as a commercial product. However, the safety of those carrying out the work, and others who may be in the vicinity, should not be compromised.

If the research work is undertaken in an academic environment then the value of instilling a laser safety culture in students who then move on to industry should not be underestimated. However, it must also be recognised that a methodology which restricts the flexibility and effectiveness of a research programme is unlikely to be adopted at the local level.

This assessment assumes that the development of the laser product is an integral part of the research. The use of an established commercial laser product as part of a research project can be considered similarly, but the assessment will hopefully determine that the risks have been addressed by the manufacturer of the laser product.

Health and safety in research establishments in the UK, including universities, is likely to be enforced by the Health and Safety Executive. Specific laser safety guidance is available for higher education establishments (CVCP 1992) but this document is now dated and does not adequately address risk assessment issues.

8.2.1 Life Cycle

A research project will have a life cycle similar to the laser display (figure 6.1), but is more likely to have progressive developmental changes. A modified life cycle is proposed as shown in figure 8.1.

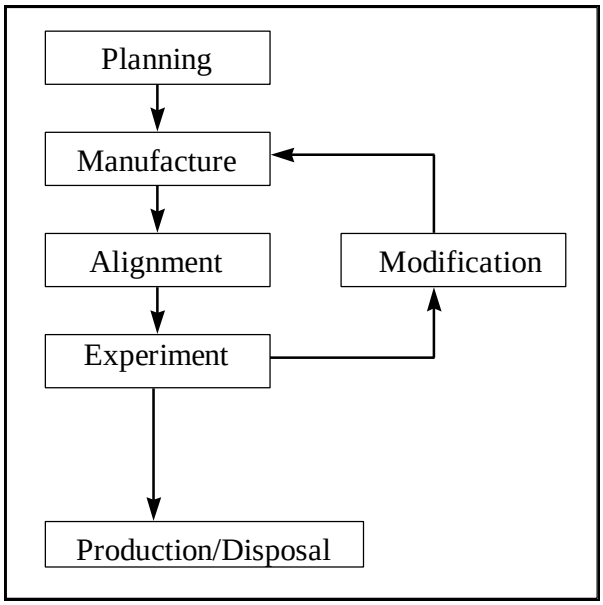

Figure 8.1 Life Cycle for a Research Project Involving an Laser

8.2.2 Hazard Identification Methodology

All of the hazard identification methodology for the display lasers (figure 6.2) is applicable, or at least should be considered. The audience could be the supervisor, or other interested parties.

The number of people at risk will generally be smaller than in laser display applications. However, special consideration should be given to staff and other people who may be in the vicinity of the research work, but not involved with it. This is particularly an issue with shared laboratories.

If the research work involves the use of a laser out-of-doors, the assessment will be even closer to the entertainment laser situation. However, it should be recognised that there is no specific requirement to involve the local authority. Special consideration should be given to the laser beam path if this is likely to present a risk to drivers of vehicles or pilots.

8.2.3 Risk Assessment

The assessment of the risks should be a systematic process making use of the hazard identification methodology, the life cycle and considering the persons at risk. Presentation of the risk assessment in a similar format to the Laser Display Safety Record would assist safety professionals within the research establishment, local managers and the person(s) undertaking the research. As the research develops, it is important to reassess the risks.

A research piece of equipment will either develop to maturity, where it is suitable for production or be dismantled at the end of the research work. Some equipment reaches maturity but remains essentially a piece of research equipment. This can mean that the risk assessment is no longer valid because the person(s) using the equipment are different to those who developed it. Their level of knowledge of laser safety issues may be much lower than the original researchers. Indeed, the equipment may be used as part of a routine process requiring little skill. Control measures, which may be tolerable during the development stage, may no longer be adequate.

8.3 Medical Laser Applications

Lasers are used in a large number of applications for diagnosis or treatment. The laser radiation is

intended to irradiate people and, in many applications, cause intentional damage to human tissue.

In the UK, the only specific legal control of the use of medical lasers is in certain private practices under the Nursing Homes and Mental Nursing Homes Regulations 1984 (HMSO 1984a) which were made under the Registered Homes Act 1984 (HMSO 1984b). Regulation 3 of the Regulations specifies class 3B and class 4 lasers as being subject to control for the purposes of the Act. Generally, it will be staff from the local health authority who will be required to assess the laser safety in the private practice. Therefore, the methodology developed for laser safety in the entertainment industry is likely to be particularly relevant to this application.

The use of lasers in hospitals forming part of the National Health Service is subject to the general requirements of the Health and Safety at Work Act 1974 (HMSO 1974) and the Regulations made under that Act. Auditing of laser safety in healthcare facilities is likely to be a function of an in-house radiation protection professional who has some expertise in laser safety. Enforcement of the safety legislation will be the responsibility of the Health and Safety Executive with the Department of Health overseeing medical practice. The Medical Devices Agency (MDA) have a rôle in the safety of equipment used in medical practice, including medical lasers. The MDA have produced guidance on the safe use of lasers in medical and dental practice (MDA 1995). This guidance provides little practical advice on assessing risks in compliance with general safety legislation but it does address a number of practical laser safety issues.

One area of laser treatment that appears to fall outside of the scope of either being a private medical practice or a National Health Service facility is beauty treatment. In particular, lasers are being used for the removal of body hair. The general laser safety can be addressed, and enforced, by local authority environmental health officers, but the clinical direction of the treatment, including assessment of competence is not clear. The practical application of the risk assessment methodology presented here should ensure that the safety issues are addressed irrespective of who enforces health and safety, and other, legislation.

8.3.1 Life Cycle

The life cycle considered here is that which effects the healthcare facility. The development of the laser, its manufacture and transport to the healthcare facility are not considered.

The life cycle within a healthcare facility is different from an entertainment laser because it also has to take account of different users and different applications of the same equipment. An outline of a suggested life cycle is presented in figure 8.2.

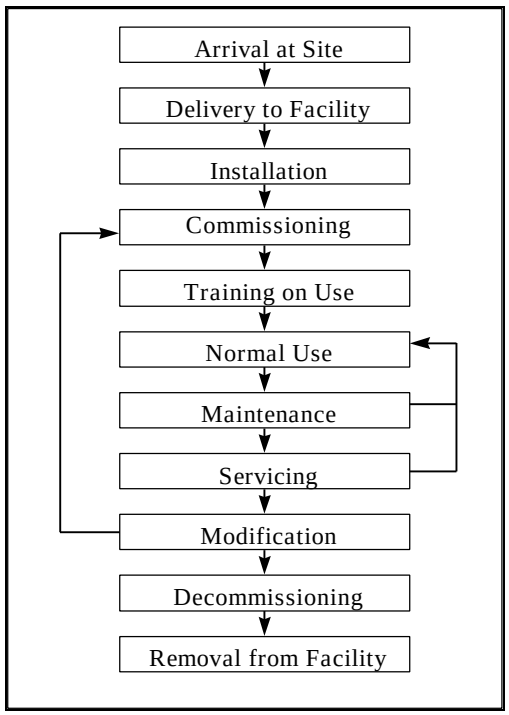

Figure 8.2 Life Cycle for a Medical Laser

8.3.2 Hazard Identification Methodology

The hazard identification methodology for entertainment lasers can be modified for medical laser applications. The audience can now be replace by the patient. The operator may be one person or it may be two. In many surgical operations, the surgeon will be termed the laser user, ie the person who presses the pedal that fires the laser at the target. The person who sets the laser parameters may be a support nurse operating under the instruction of the surgeon. This nurse will put the laser into the "ready" mode, essentially giving the surgeon the ability to fire the laser.

As part of the consideration of the beam paths, the laser process will have to be considered, bringing the model in line with the original model developed by Tyrer *et al* (1994). Since surgical applications cause damage to human tissue, which may be diseased, it is important to consider the resultant fume.

Hazards may be accessible during some parts of the life cycle and not others. For example, work carried out during commissioning, servicing and modification may involve the side panels of the laser being removed and the laser operated with interlocks overridden. Apart from the laser radiation hazard, collateral radiation and high voltages may be accessible.

8.3.3 Risk Assessment

There are several reasons why the risk assessment is important in a healthcare facility. Many such facilities have a number of risks and are generally operating under strict financial constraints. The risk assessments provides input to a cost-benefit exercise which balances all of the risks associated with the work in the healthcare facility.

The control measures in place during different parts of the life cycle may not be adequate for all persons potentially at risk. For example, during servicing operations the engineer, who may be a contractor from the laser supplier, may use adequate control measures to protect themselves (wear laser safety goggles) but not consider other people in the vicinity. The risk assessment from the laser supplier

should address this, or the issue should be addressed by the healthcare facility.

Many healthcare facilities are large with multiple laser applications. Presentation of the risk assessment and other information in a formal record similar to the Laser Display Safety Record summarises the status of laser safety. Unlike many laser display installations, the record will be relatively static, although it is important that it is reviewed periodically and when circumstances change. This can include the purchase of new equipment, re-siting of existing equipment, new medical procedures or the transfer of physical direction of the process to another group of staff. An example of the latter is where a nurse undertakes tattoo removal or the treatment of benign vascular lesions under the clinical direction of a physician.

The use of a formal Record is also useful for demonstration of regulatory compliance, including compliance with the Registered Homes Act (HMSO 1984b). The officer assessing a private healthcare facility for registration under the Act will be able to judge the laser safety infrastructure and risk assessments on the basis of information already recorded rather than having to seek the information by interview.

The risk assessment methodology described here, and written by the author, has been incorporated in Annex C of a draft International Electrotechnical Commission report on medical laser safety to be published as part 8 in the IEC 60825-X series (IEC 1998).

8.4 Industry

The use of lasers in industry is widespread with applications varying from manufacture to quality assurance. The objective should be to ensure that personnel are not exposed to the laser radiation and other hazards associated with the use of the laser. Lasers in industry may be used by people who have no awareness of laser safety issues, and ideally, should have no need to understand the laser safety issues if these are addressed satisfactorily during the design and manufacture stages.

8.4.1 Life Cycle

The life cycle for a laser product used in industry may include the life cycle for a research application. However, it is assumed here that the life cycle commences with the customer identifying a need for a piece of equipment. The manufacture and supply of the equipment is not considered.

The life cycle is identical to that for the medical laser (figure 8.2). In some applications, such as materials processing, the different tasks undertaken by the laser product may present different safety issues.

8.4.2 Hazard Identification Methodology

Ideally, laser radiation will be less of a safety issue with industrial laser products. However, the hazard identification methodology for entertainment lasers can still be adapted for these applications. As with the medical lasers, the laser process may be more important than the beam path. A suggested hazard identification methodology is presented in figure 8.3.

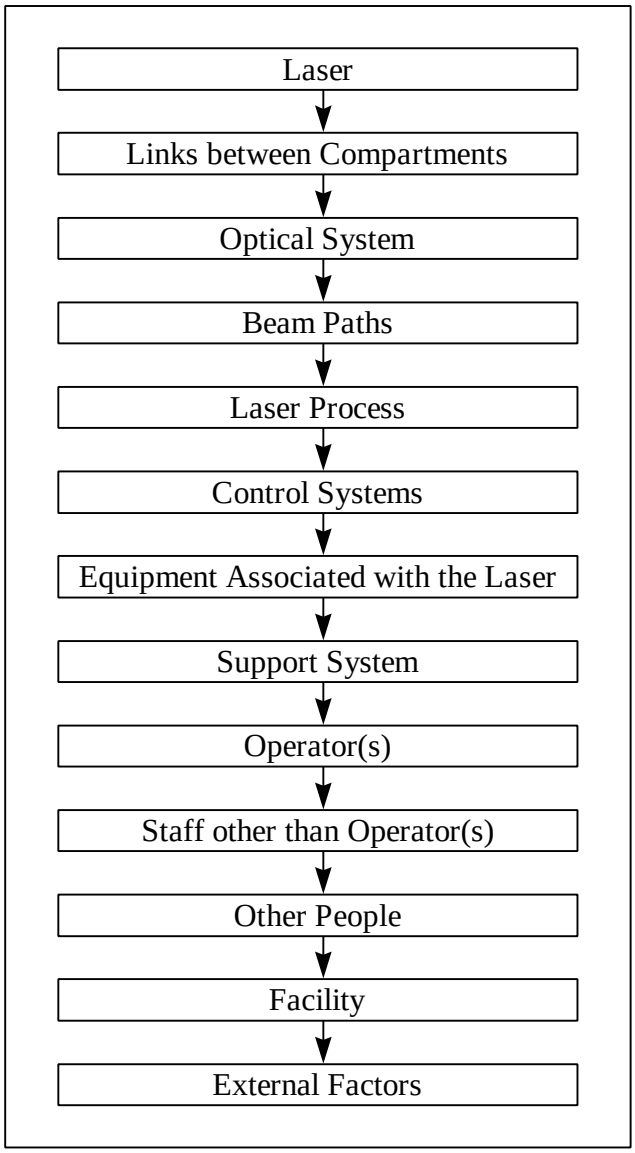

Figure 8.3 Industrial Laser Hazard Methodology

The number of people at risk from industrial applications is generally small and will usually be restricted to employees or contractors working on the laser product. However, consideration should also be given to visitors and to employees who may be at particular risk through ignorance, such as recent recruits and cleaning staff.

8.4.3 Risk Assessment

Risk assessment should be a routine activity for many companies using lasers in industry. The use of the hazard identification methodology and following this through to the risk assessment for the laser application should form part of the company's overall risk assessment.

The risk assessment, and the other information relating to laser safety, could be presented in a ring binder file similar to the Laser Display Safety Record, although it is more appropriate to call this a Laser Safety Operational File. This format has been used by the author for a number of industrial applications.

8.5 Summary

The hazard identification and risk assessment methodology were developed initially for the entertainment industry. However, the methodology can be adapted to a number of different laser applications. Indeed, the structured approach can be applied to any application.

It is recognised that some applications will require a more formal approach to failure analysis and risk assessment but these generally apply at the design and manufacture stage. By the time a product reaches the user, most of the safety issues should have been considered and addressed. The requirement to undertake a risk assessment remains under UK law. It is compliance with this requirement that the methodology described in this chapter should help to address.