ANSI Z136.1-2014 Definitions Directly Affecting your Interlocking Decisions

Maximum Permissible Exposure (MPE): The level of laser radiation to which an unprotected person may be exposed without adverse biological changes in the eye or skin.

Interlock Definition: The term "Interlock" refers to a hardware device which, when activated, will immediately reduce the laser emission below MPE levels. This device may be a mechanical or electrically activated shutter, or it may be an electrical trip of the laser system power source. The interlock is often broadly defined as a room interlock system, whereby access controls, door or floor sensors, or motion detectors are interconnected to cause a rapid reduction in laser emission below the MPE when activated.

Reasons for Interlocks: When dealing with class 3B and class 4 lasers, the danger is real, not just a sign on the door. The ANSI Z136.1 definition on the use of the Danger sign reads:

"DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme conditions."

Engineered safety interlocks and entryway controls are a method of ensuring that seriously dangerous systems (Class 4) are contained and respected. Proper implementation of the interlocks will limit the laser access to qualified, trained individuals and help prevent harm to those who are not properly trained on the operation and safe use of the laser.

One of the most difficult tasks a laser safety officer will perform is the accurate calculation of the nominal hazard zone (NHZ) for a laser system. To make matters worse, the laser layout in a research or educational setting can change with every experiment. The release of ANSI Z136.1-2007 has now simplified this task. In lieu of performing the calculations, the LSO can simply declare the entire room as a laser area and provide adequate controls at the perimeter of the room. These controls are most often implemented using interlocks and engineered access controls.

Engineering Controls:
ANSI Z136.1 states: "Engineering controls (items incorporated into the laser or laser system or designed into the installation by the user) shall be given primary consideration in instituting a control measure program for limiting access to the laser radiation"

Engineering controls for laser safety concentrates on three specific areas:

A. Physical protection from the hazard in the form of curtains, enclosures or barriers
B. Visual warning of the hazard in the form of signs and electronic warnings
C. Engineered Area or entryway safety controls to control access and trip the interlock if needed.

Engineered Area or Entryway Safety Controls for Class 4 Lasers or Laser Systems:
Class 4 laser areas have the potential to be extremely hazardous to untrained and unprotected personnel and require stringent protection. ANSI Z136.1 gives a choice of three methods that can be used to mitigate the hazard.

I. Non-defeatable (non-override) Area or Entryway Safety Controls
II. Defeatable Area or Entryway Safety Controls
III. Procedural Area or Entryway Safety Controls

The non-defeatable and defeatable methods employ engineered safety devices and are the preferred method of controlling the laser hazard. The procedural method is not an engineered safety control method and is only recommended for limited specialized applications.

I. Non-defeatable Area or Entryway Safety Controls:
Non-defeatable means "cannot be defeated". The non-defeatable safety circuit is the safest, simplest, and least expensive type of engineered safety control. The interlock connection of a class 4 laser (or shutter at the output of the laser) is connected to a safety circuit that extends to one or more limit switches at the entryway door(s). In operation, the circuit performs as follows: Open the door and the laser turns off or the shutter closes.

The non-defeatable entryway control is the ANSI preferred method of protection. It has the advantage of not requiring complex barriers or expensive laser curtains at the doorway since the door is the interlocked barrier.

II. Defeatable Area or Entryway Safety Controls:
A defeatable safety control is a type of room interlock that allows authorized trained personnel to momentarily defeat (bypass) the interlock limit switches at a room entryway in order to enter and exit the room without interrupting laser operation. In order to be safe and effective, it is crucial that the level of laser radiation does not exceed the MPE at the entry point. This often requires the installation of barriers or laser curtains at the interior of the entryway. *It is important to note that the ANSI Z136.1 standard recommends the defeatable interlock only if non-defeatable interlocks limit the intended use of the laser or laser system.*

III. Procedural Area or Entryway Safety Controls:

"Where safety latches or interlocks are not feasible or are inappropriate, for example during medical procedures, surgery, etc., the following shall apply: …."

The ANSI Z136.1 standard is clear. The procedural method is only to be used where the non-defeatable and defeatable interlocks are not feasible or are inappropriate. The example of the surgical laser is indeed one of the few appropriate cases for the use of a procedural method. The interlock exception is being granted to lasers used in medical procedures for the following reasons:

1. No one wants to inadvertently secure a laser in the middle of a medical procedure by tripping an interlock.
2. The flow of traffic in and out of a surgical area cannot be impeded when life safety is involved, so door locks or entryway switches are inappropriate.

The Procedural Entryway Safety Control method uses the following assumptions:

1. The laser is under the active control of an operator who can quickly secure the laser in the event of an emergency. (Supervised laser operation)
2. All personnel are adequately trained and provided with personal protective equipment upon entry.
3. The exposure must be less than MPE at the entryway. Curtains, laser type, and room design are evaluated to meet this condition.
4. A visible or audible signal is provided at the entryway indicating the laser is energized and operating at Class 4 levels.

Other than the surgical laser situation, there are few valid scenarios that can justify the use of the procedural area or access control protocol for a Class 4 laser area. It is worthwhile to note that even within ANSI Z136.3 (Safe Use of Lasers in Health Care Facilities,) sections 4.1 and 4.8 state that when a laser is not being used on a human patient, it shall be interlocked in accordance with the more stringent requirements of ANSI Z136.1.

Unattended Laser Operation:

The unattended use of Class 3B or Class 4 lasers or laser systems shall be permitted only when the LSO has implemented appropriate control measures that provide adequate protection and laser safety training to those who may enter the laser controlled area during times of unattended use.