COLASE (COMMON LASER SAFETY ENVIRONMENT)

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Abstract

CoLaSE (Common Laser Safety Environment) is a hardware and software solution to understand and manage real-time laser safety risk, as driven by the source.

Introduction

CoLaSE creates a real-time monitoring, reporting, and control environment for lasers and other light sources. This information will be processed in real-time for experiment and access control, and to display on a monitor (as a room sign)-prior to entry.

A Common Problem With a Valuable Solution

The common problem with directly linked-in laser sources via Class IIIb/3B / Class IV/4 engineering controls, is the limited functionality and reporting of the majority of interfaces (typically, the remote interlock connector) used by laser manufacturers. Most often, the only information provided is power supply status and shutter/interlock disposition. CoLaSE provides the same basic information regarding the operational aspects of the laser source, but provides a more dynamically rich data set. A compact circuit board will be located in the power supply, control panel/surface, or laser head itself. The information from the interface would contain the following:

- Power supply status
- Shutter position
- Interlock chain status
- Power/Energy requested including
- Pulse width
- PRR
- DC
- OD (with TLV)
- Personnel including
- Facility/Safety Manager
- LSO/ALSO
- Security/First Responder

Once sent to the control/processor, the laser operational information is merged with facilities and personnel data for a more complete and less risky safety picture.

CoLaSE addresses the difficult issue related to the laser safety environment of static v. dynamic laser installations (see Figure 1). Depending upon the type of industry, a laser's installation maybe static (not frequently moved in and out of a controlled space) or dynamic (maybe mixed with other lasers and or moved to a different location within the controlled space without proper cognizance. This is an area of some concern.

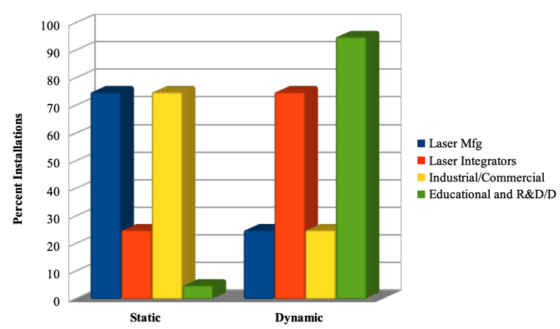

Figure 1

Types of installations versus static and dynamic laser placements

Example 01: Laser Manufacturer

Laser manufacturers typically have laser product lines tested in batches or have a dedicated test cell. So their installation risk is typically more static than dynamic.

Conversely,

Example 02: Educational and R&D/D

Educational institutions and research and design/development groups typically do not work on the same or a singular type of laser. Although there are exceptions with respect to use of analytical tools in laboratories, almost every experiment or development effort requires a different source. Their installation risk is therefore typically more dynamic than static.

Although CoLaSE will be a critical component of the safety architecture of any organization, it is best suited for laser integrators and educational and R&D/D groups because it can track the dynamic installation risks that other solutions cannot.

A Safety Chain

A great place to start to understand the gaps filled by CoLaSE is the safety chain- see Figure 2 below:

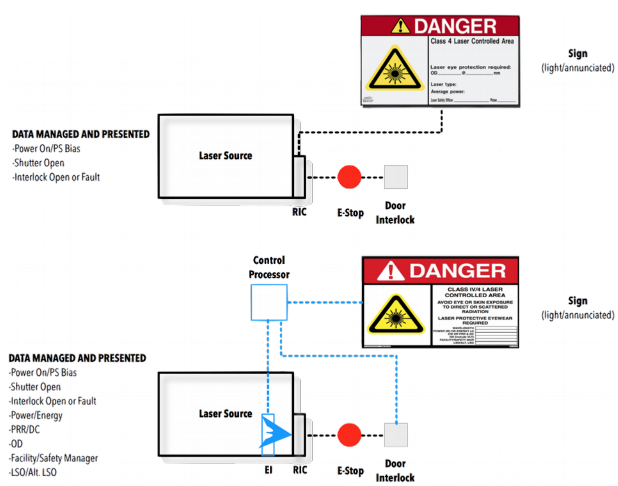

Figure 2
Current and CoLaSE Safety Chains

Manufacturers would be provided Application Programming Interface (API) software with the electronic interface so that they may code the portion of the board which describes the laser source, specifically which parameters are constant (e.g., safety interlock process and control), and variable (e.g., power, beam dynamics, etc..). Additionally, personnel-variables such as training level, position within the company, and granted access, can all be either manually coded or automated.

Both Commercial Off The Shelf (COTS) and Modified COTS (MCOTS) solutions are robust in the safety chain as long as the installation is static in nature.

CoLASE provides more meaningful intelligence than currently exploited and specifically goes further to:

- report the actual performance called for and exhibited;
- using ES and AI (and basic rule engines) for controls/access
- provide real-time signage to reflect emission characteristics, actual hazards and control indications (see Figure 3 below)

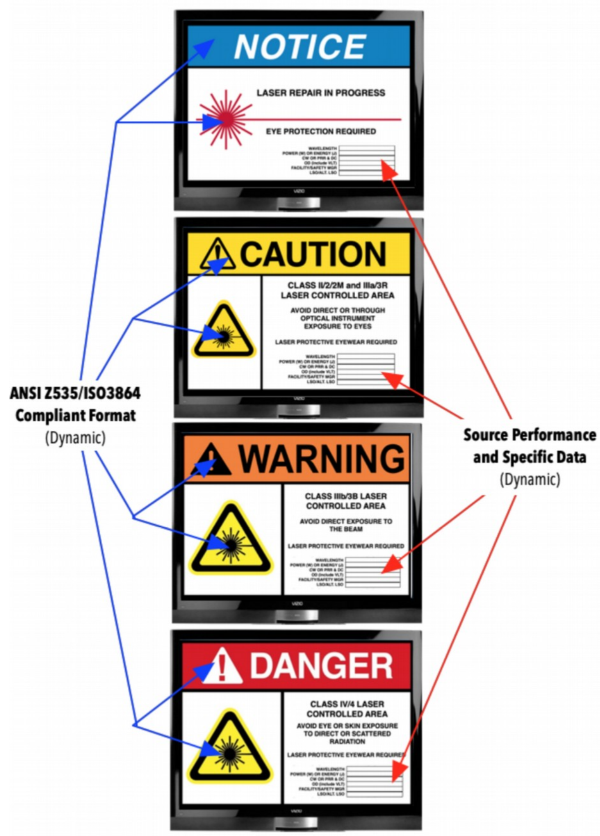

Figure 3
Interactive Signage

Data Generated

CoLaSE has the ability to gather performance data more advanced than that of basic product performance telemetry. User-based behavior can generate big data sets. The resulting data and related Expert Systems (ES) generated can:

- Assist source manufacturers with never-before-realized use data, which will reveal:
  - Engineering substitution (what was ordered as a source vs. what is actually used and how);
  - Operability vs. performance and how that affects End Of Life (EOL) predictions and mitigation.
- Assist Safety Industrial Health (SIH)/Environmental Health and Safety (EHS) and LSO/ALSO personnel with better understanding of actual level of risk at any one time.

Stage 1- Proof Of Concept

The goal of Stage 1- Proof Of Concept, is to create a prototype which proves the basic operability of the concept. Specifically we have created a functioning prototype using COTS and MCOTS components. A diagram of which is shown in Figure 4 below:

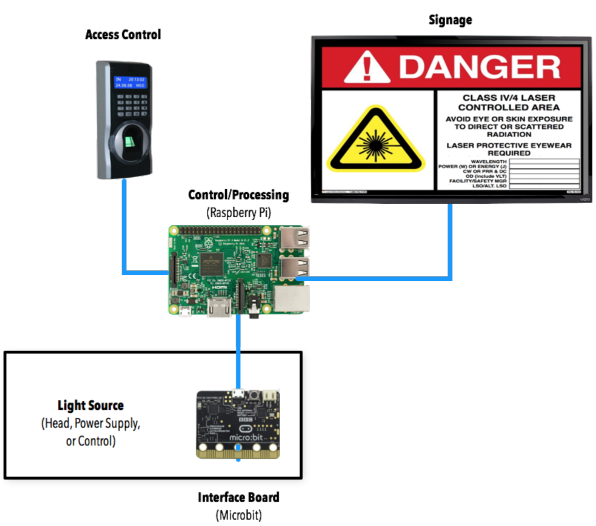

Figure 4
Stage 1 Diagram

Stage 1 Results

Proof-Of-Concept prototype demonstrates:

- Real-time status of source. We are using a LaserPhysics Air-Cooled Argon Ion laser, but applies to any source of light radiation.

- A relatively simple interface board which resides within the laser itself. We are using a Microbit processing board with Bluetooth Low Energy (BLE) for communications.

- A control/processing board runs software-based rule engines to allow/deny access and experiment operability as well as drive display devices. This is being accomplished by using a Raspberry Pi processing board.

- Display system which offers not only ANSI-approved signage, but other facility-related safety information as well.

Current progress on the Stage 1 hardware is shown below in Figures 5 and 6.

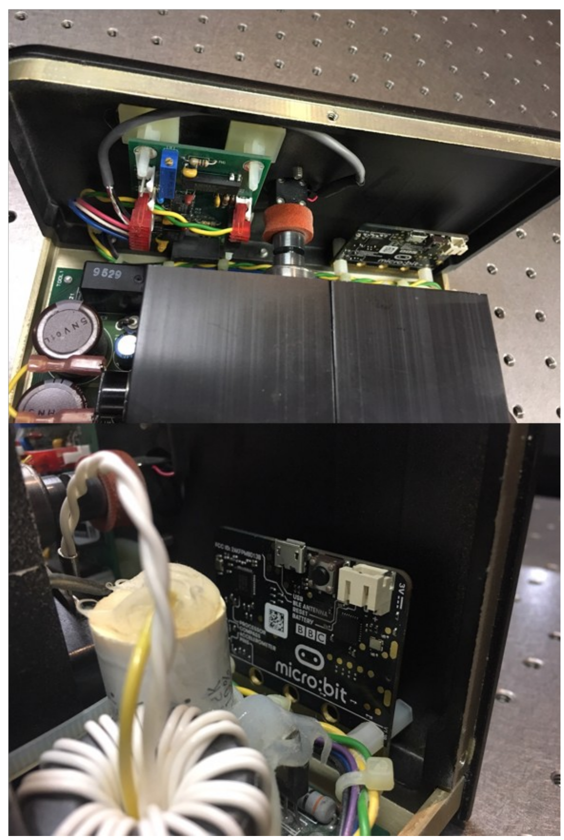

Figure 5
Stage 1 Progress
(Installation and Positioning of Interface Board)

Figure 6
Stage 1 Raspberry PI connected to a microdisplay

Stage 2- What's Next?

The next steps in the evolution of CoLaSE are:

1. Development of a Beta (Test and Evaluation) hardware and software suite to be applicable to as many types of sources as possible.

2. Hold a round-table discussion with top manufacturers to discuss how best to integrate CoLaSE technology (namely the interface board and interconnections) with CDRH, IEC, and ANSI buy-in.

3. Manufacture a sample production run (Low Rate Production) of a couple dozen kit units to be sent to partner manufacturers for use and evaluation as "options" on standard products.

4. Evolve the system into an open standard and have the community assist and buy into further development.

Conclusion

The current state of technology readiness is mature enough in each of the constituent parts to create an efficient CoLaSE ecosystem.

So much more than IIIb/3B and IV/4 engineering controls, CoLaSE will provide meaningful, real-time information about how a laser (or any light source) is used, controlled, and the best safety infrastructure to manage its' risk.

Meet the Author

Scott Wohlstein is the President of The Photonics Group. He has 39 years of experience assisting in the design, development, and production of safe, US and EU compliant Photonics-based products and processes. He is known for his work in areas such as R&D/D management, safety/risk, and troubleshooting. Scott has served on the editorial advisory board for Lasers & Optronics, editor for Measurements and Controls, and serves on ANSI Z136 committees.