Safety Interlock System Design and Installation: Lessons Learned

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• **Illuminated "Laser On" warning sign**, posted at each entrance, lit laser tube energized
• [If defeatable interlock system] **Curtained entryway enclosure** at the primary entrance to the laser lab
• **Protective eyewear station** inside the lab near the main entrance, within curtained entryway enclosure
• **Laser-resistant beam shutter** activated as specified
• **Interlock on Entry Door(s)** to activate shutter (and requiring manual reset) upon opening door
• **Emergency "Beam Off" buttons** to activate shutter
• **Emergency "Power Off" button** (labs with HV devices)

www.safety.duke.edu/RadSafety/laser.asp
Entryway Safety Design Project – Brief History


2005: Major Class 4 laser user agrees in principle to comply with Guide once his lab moves to another building, **IF** Duke provides a system that *requires no thought or action by lab staff* to function properly (i.e. no disruption of laser operations)

2007: Administration agrees to plan; formal design team convened to establish standard design. Physics gets similar system operational in same building.

1/24/08: Design team submits final design in January; a new faculty member’s lab targeted for initial installation

12/19/08: Installation completed in one of two labs
**Basic Design**

**SHUTTER CONTROL**
- E-Stop
- +24Vdc
- Door Sw.
- Bypass Sw.
  - [Reset] Interface

**SIGN CONTROL**
- +24Vdc
- 120Vac
- Neutral
  - “Laser On” Illum. sign

[Shutter open or laser interlock crkt closed only when 24Vdc applied]
[Sign lit only when terminals shorted]

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**User’s Shutter or Relay**

**User’s Laser Connection**

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**DLS Duke Laser Safety**
Recent Developments

• Card access glitches plague prototype installation; lab staff disenchanted with system
• At the request of Maintenance Dept, design team reformat design document into “electrical subcontractor friendly” format, based on experience gained during the one successful lab installation
• Revised design document submitted mid February 2009
• Partial installation stalled in that faculty member’s other (larger) lab
• No progress on installation of system in original laser user’s lab
Example Circuit Diagram vs. Wiring Diagram
Lessons Learned

Worked Well:
1) Physics (TUNL & DFELL) expertise on design team
2) Building a working prototype
3) Soliciting user feedback before, during, and after

Bad Assumptions:
1) Maintenance “Electrical” group would transform rough circuit diagram into finished plan for electrical subcontractor
3) Electrical subcontractor can install control circuits as easily as Physics staff did in another lab in same building
2) Having committed to the plan, Administration would follow through and get it done in a timely fashion
Regrettably Impossible Fix

**OBVIOUS** Solution: Replace card reader interface with Biometric entryway system

- Reduce cost by 10’s of k$
- Reduce installation time by ~1 year
- Trend in security for past decade; future standard
- Appropriate for number of users
- Well-established track record

Unfortunately this solution runs counter to DU Administration’s prohibition on non-DukeCard entry systems
Next Steps

2. Maintenance sending final design standard to an outside electrical contractor for review & comments (i.e. “does this document have all the information you would need to install this system”)

3. Continue working with Maintenance/Contractor to finish installation in larger laser lab.

4. Launch marketing effort with lab staff to instill confidence in system

5. Once this demonstration project has established a good track record (and economy has improved to the point Duke may consider facility upgrades), pursue upfit of this system into original laser user’s lab