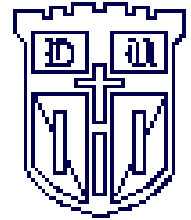


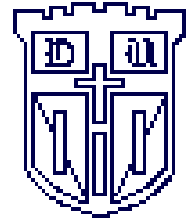
Safety Interlock System Design and Installation: Lessons Learned

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Duke Laser Safety Class 4 Laser Lab Design Guide

- 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)



Entryway Safety Design Project – Brief History

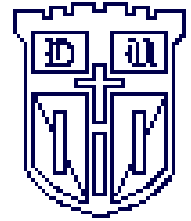
2004: LSC approves Class 4 Laser Lab Design Guide, incorporating ANSI Z136 requirements for laser labs

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.

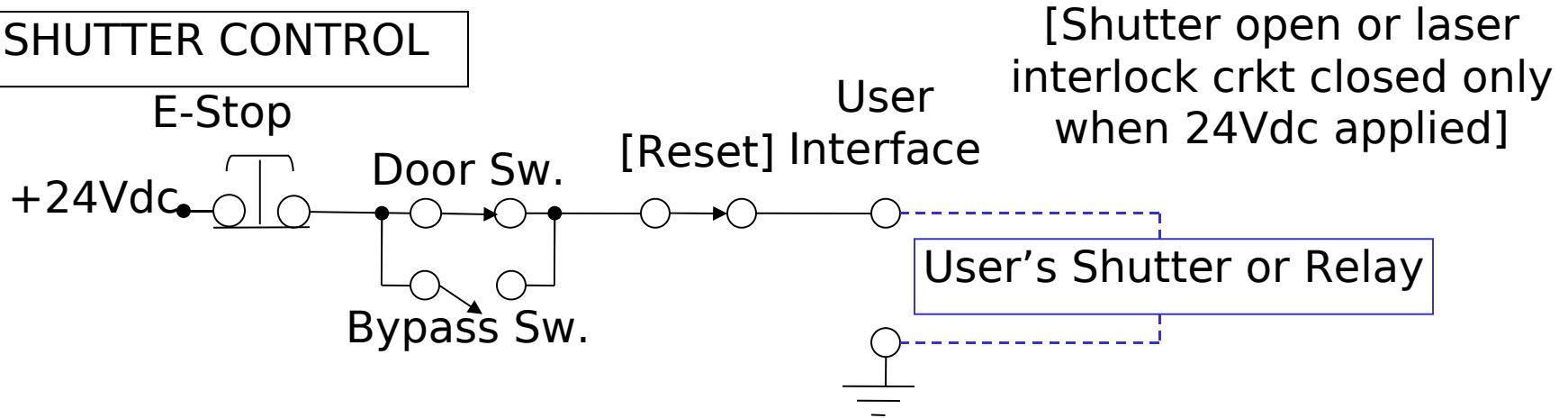
1/24/08: Design team submits final design in January; a new faculty member's lab targeted for initial installation

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

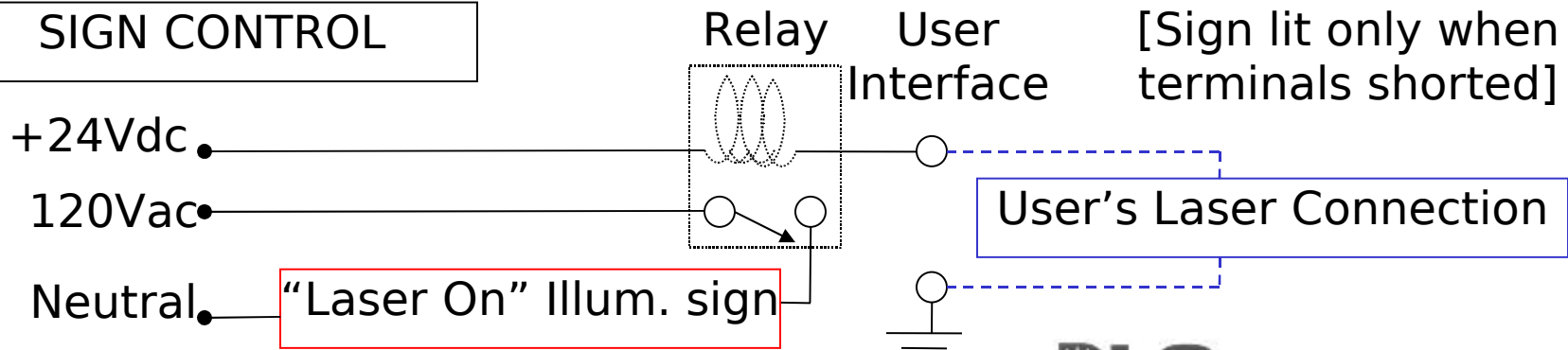


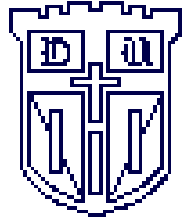
Basic Design

SHUTTER CONTROL



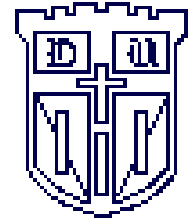
SIGN CONTROL



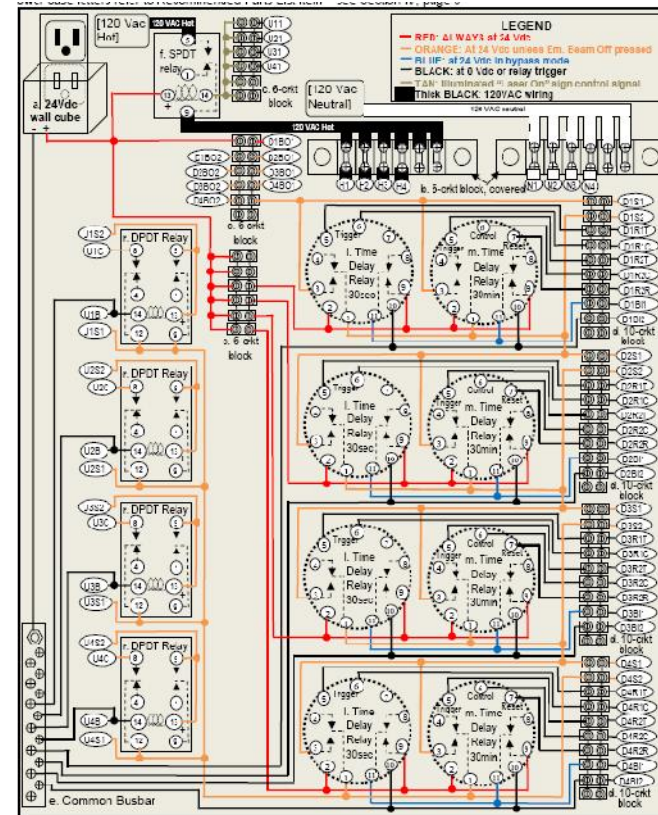
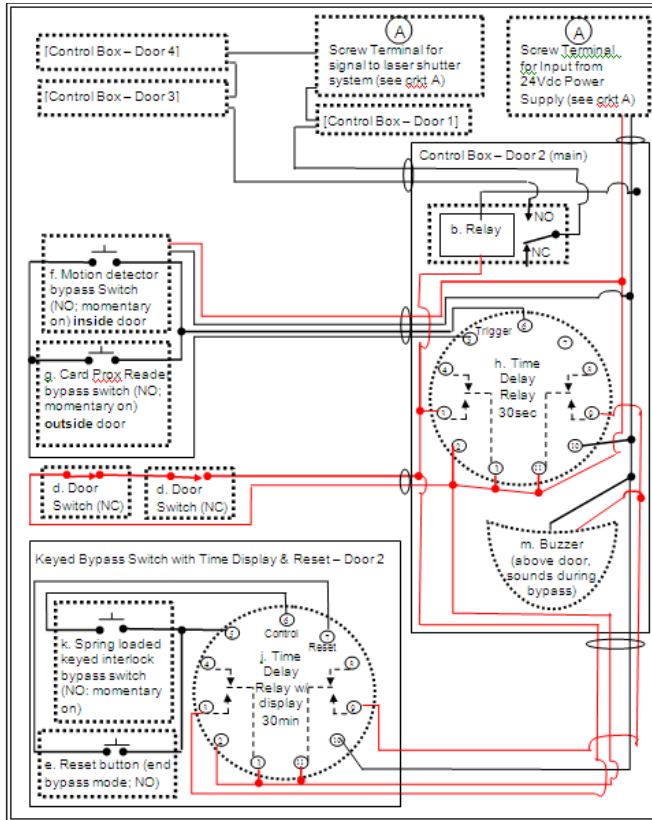


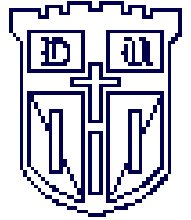
Recent Developments

- Card access glitches plague prototype installation; lab staff disenchanted with system
- At the request of Maintenance Dept, design team reformats 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





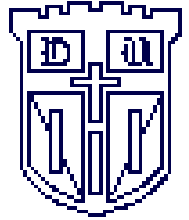
Lessons Learned

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

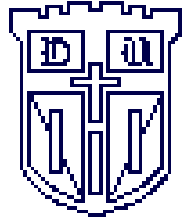


Regrettably Impossible Fix

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