

Laser Safety Systems for the LCLS-II and FACET-II Photo-Injectors

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Accelerator Safety Workshop

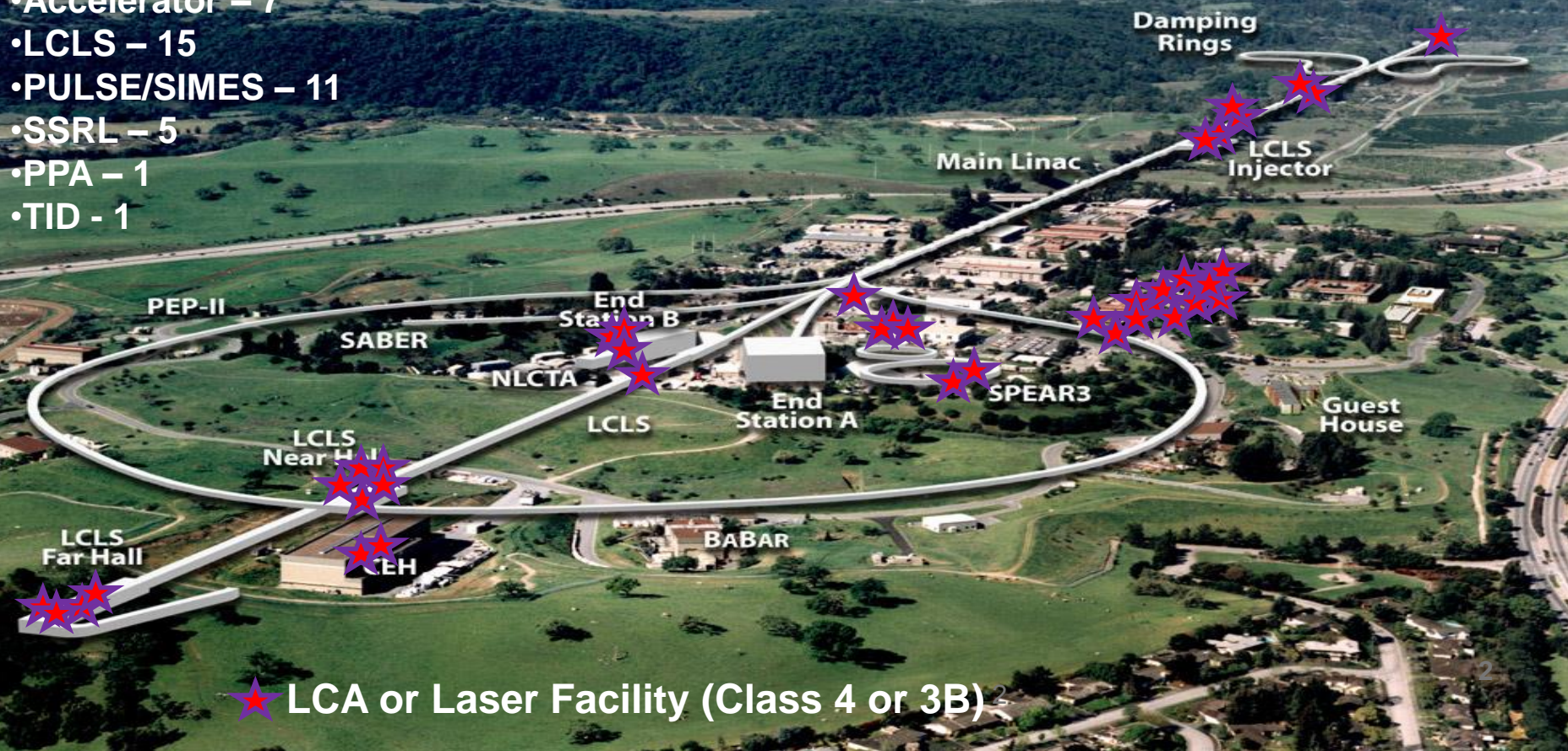
SLAC, August 21-23, 2018

Laser Operations at SLAC

390 Laser Workers

40 Laser Facilities

- Accelerator – 7
- LCLS – 15
- PULSE/SIMES – 11
- SSRL – 5
- PPA – 1
- TID - 1

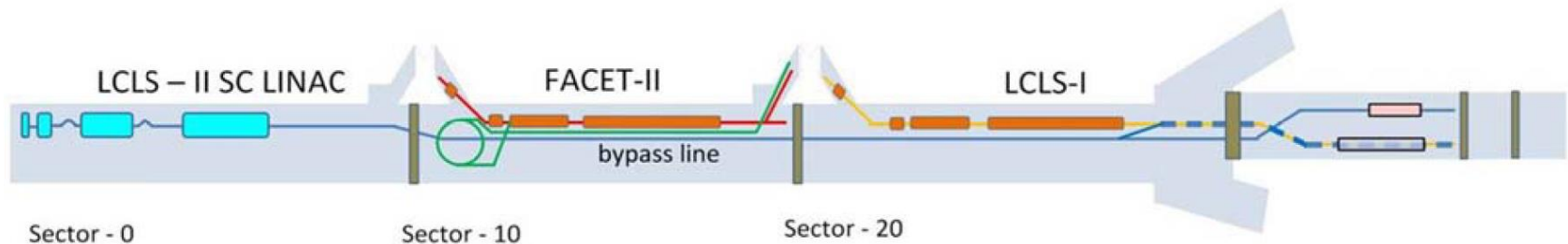


★ LCA or Laser Facility (Class 4 or 3B)

- ❑ LCLS-II and FACET-II projects
- ❑ Laser hazards
- ❑ Laser Safety System (LSS) principles and architecture. Operation Modes.
- ❑ FACET-II
- ❑ LCLS-II
- ❑ Safety Documents (SOP, IAT, ICD)
- ❑ Current Status

LCLS-II and FACET-II

- ❑ LCLS-II – Linac Coherent Light Source – the new superconducting linac-based high rep rate X-ray FEL.
- ❑ FACET-II (Facility for Advanced Accelerator Experimental Tests) - new test facility to develop advanced acceleration and coherent radiation techniques with high-energy electron and positron beams.



Lasers and laser hazards

Optical Laser hazards (180 nm – 1 mm)

Class 3B and Class 4

- eye damage
- skin burns and fires for Class 4

Class 2 and 3R

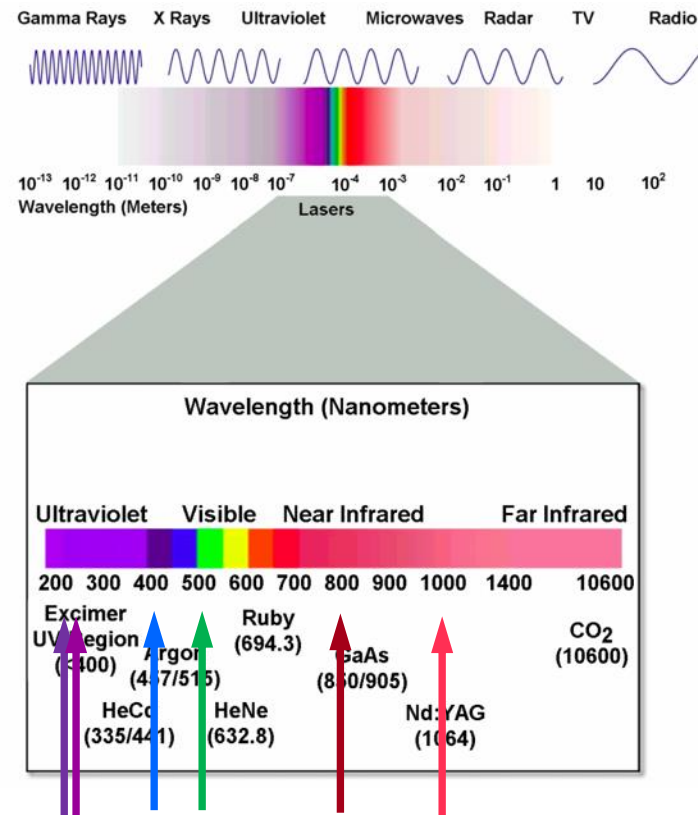
- startle hazard

Class 1

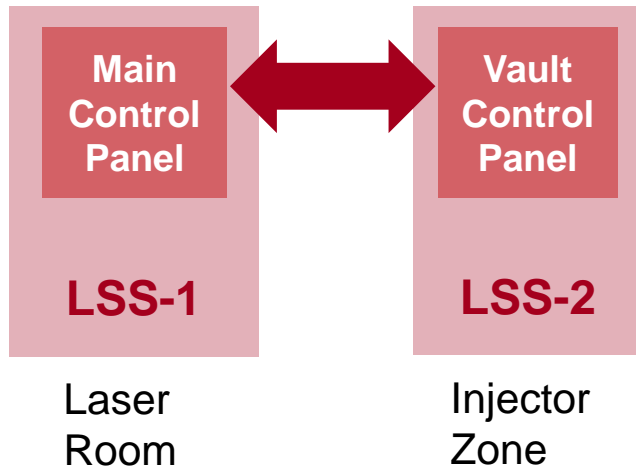
- Low power or fully enclosed 3B and 4.
- Not hazardous.

□ LCLS-II and FACET-II Photo-injector lasers:

800 nm, 1030 nm – IR. Harmonics: 400 nm, 515 nm, 267 nm, 257 nm.



Laser Safety System (LSS) – basic principles and architecture



- LSS-1 for the Laser room (sources) and LSS-2 for the Injector Zone (Vault/gun) have a common PLC, but are largely **independent**.

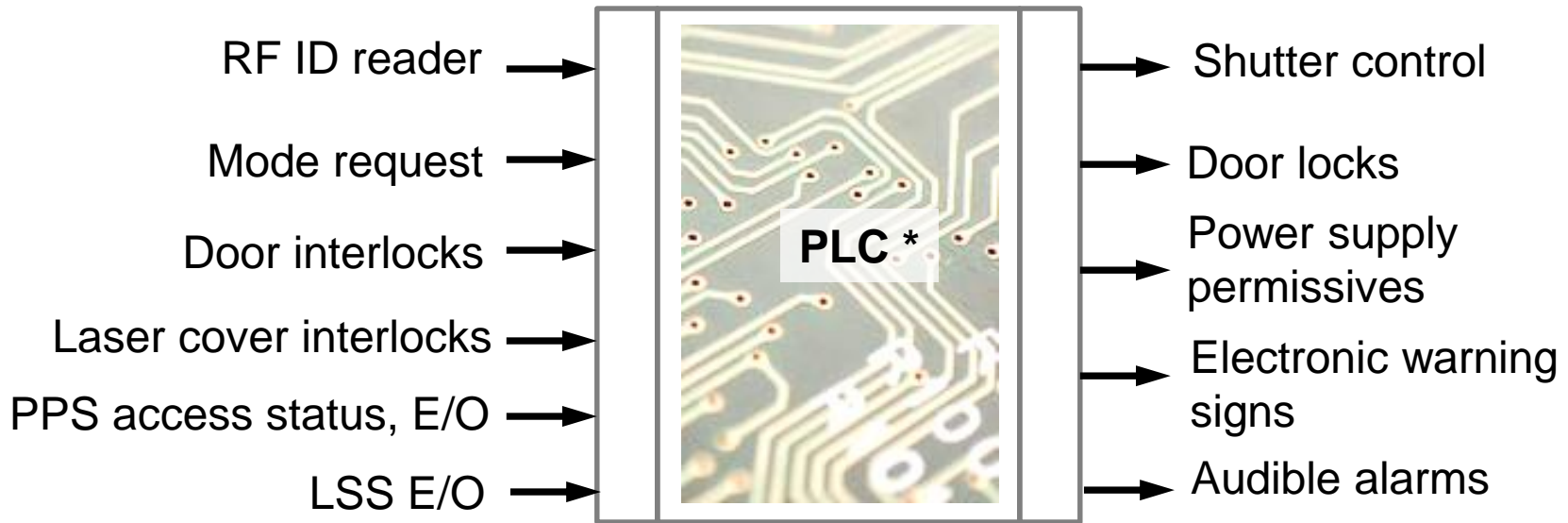
- LSS-2 in the Injector Zone can admit the laser hazard in the Vault (open transport shutters) when personnel are present. Transport shutters open automatically when Injector Zone secured to be rad ready.



- Laser Safety Systems (LSS) receives PPS* signals (Injector Zone Secure and Emergency Off) but does not provide any input to PPS. Interface is specified in an Interface Control Document (ICD).

*PPS is the Access Control System that prevents access to RCAs when beam hazard may be present

LSS Principles



* PLC – Programmable Logic Controller

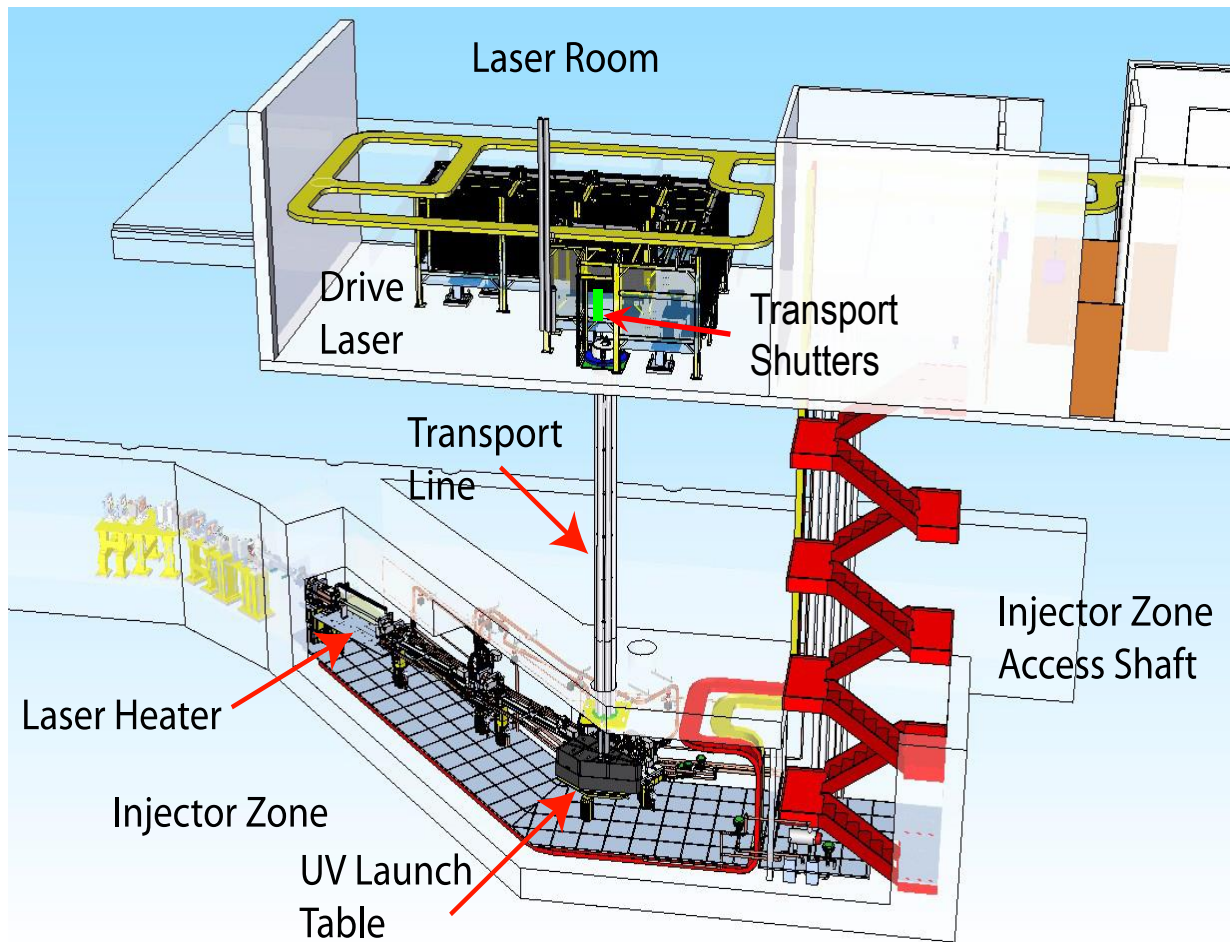
Laser Room Operation Modes

Operation Mode	Accessible Class 3B or Class 4 laser?	Eyewear
Class 1 Non-Operational	No. Laser shutters closed	None
Class 1 Operational	No. Laser shutters open. Beam in interlocked enclosure and transport tube	None
Class 4 Normal	Yes	Required
Class 4 Maintenance	Yes. Laser covers are open, upbeam of safety shutter.	Required

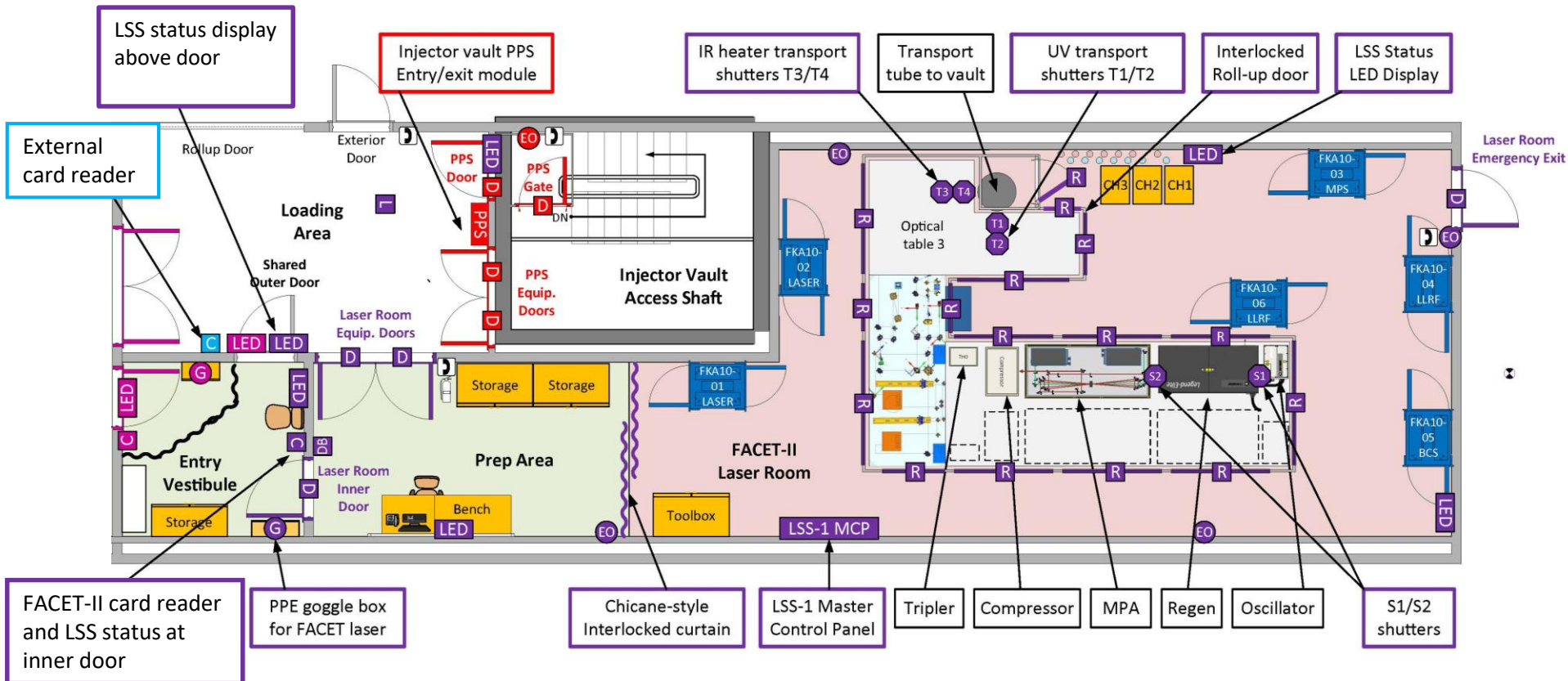
Injector Zone Operation Modes in Permitted/Controlled Access

Operation Mode	Accessible Class 3B or Class 4 laser?	Eyewear
Class 4	Yes	Required
HeNe Alignment Laser	No. Laser Shutters are closed and disabled, but Transport Shutters are enabled and can be open.	No

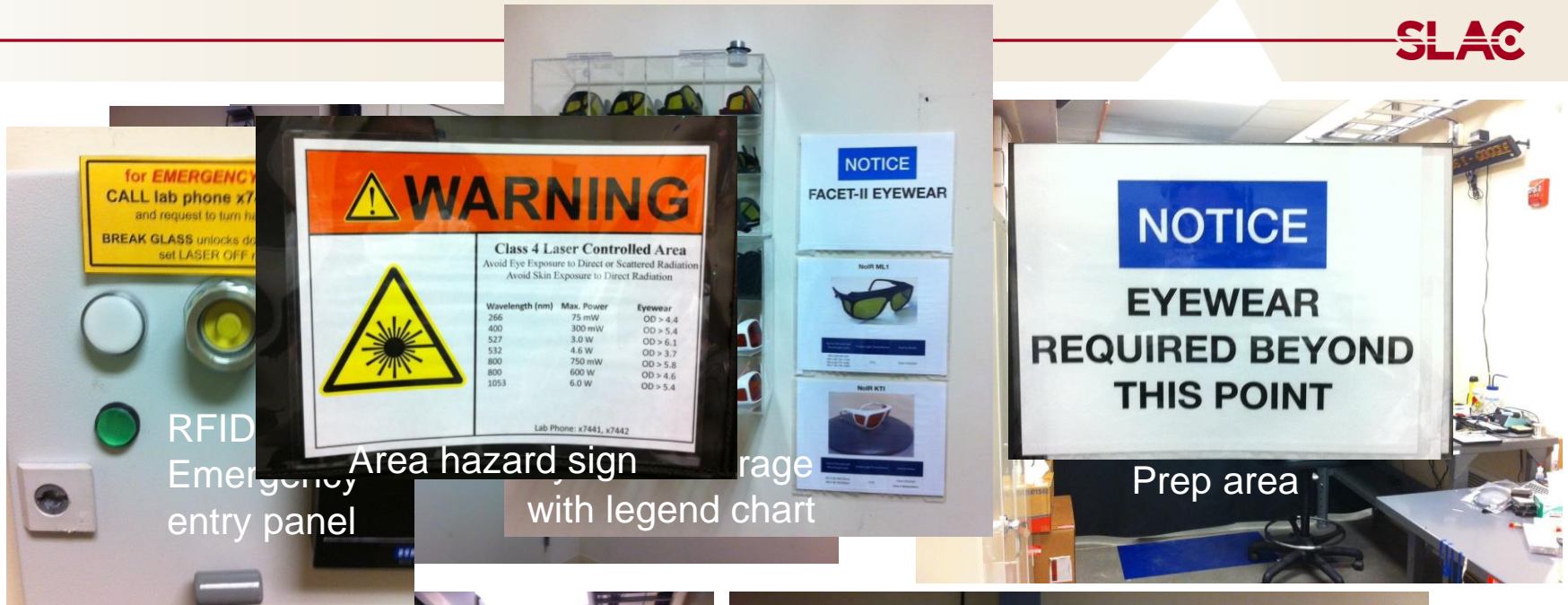
FACET-II laser system - layout



FACET-II Laser room LCA



FACET-II Laser room



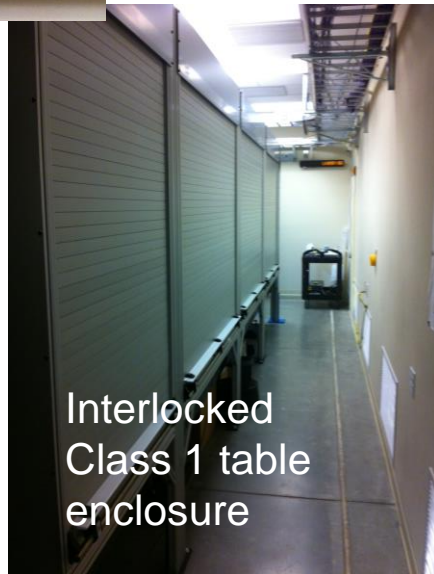
RFID
Emergency
entry panel

Area hazard sign
with legend chart

Prep area



E/O button
Interlocked
Class 1 table
enclosure



Interlocked
Class 1 table
enclosure



MCP

LSS Main Control Panel Screens

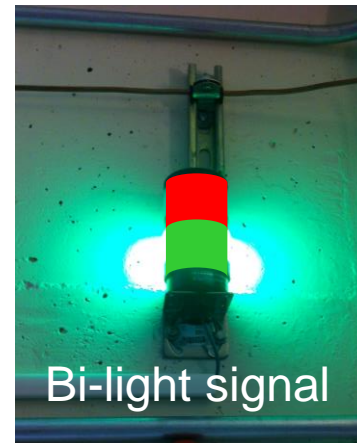
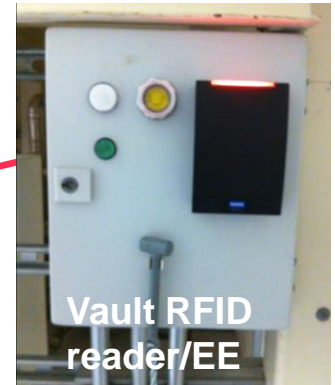
Main screen

Interlock Name	Current State	Latched State
Master Key	OFF	
MCP Vault Key	OFF	
Power Supply	Tripped	
Shutter Enable	Tripped	
Shutter State Fail	OK	
Break Glass	OK	
E-Stop #1	OK	
E-Stop #2	OK	
E-Stop #3	OK	
E-Stop #4	OK	

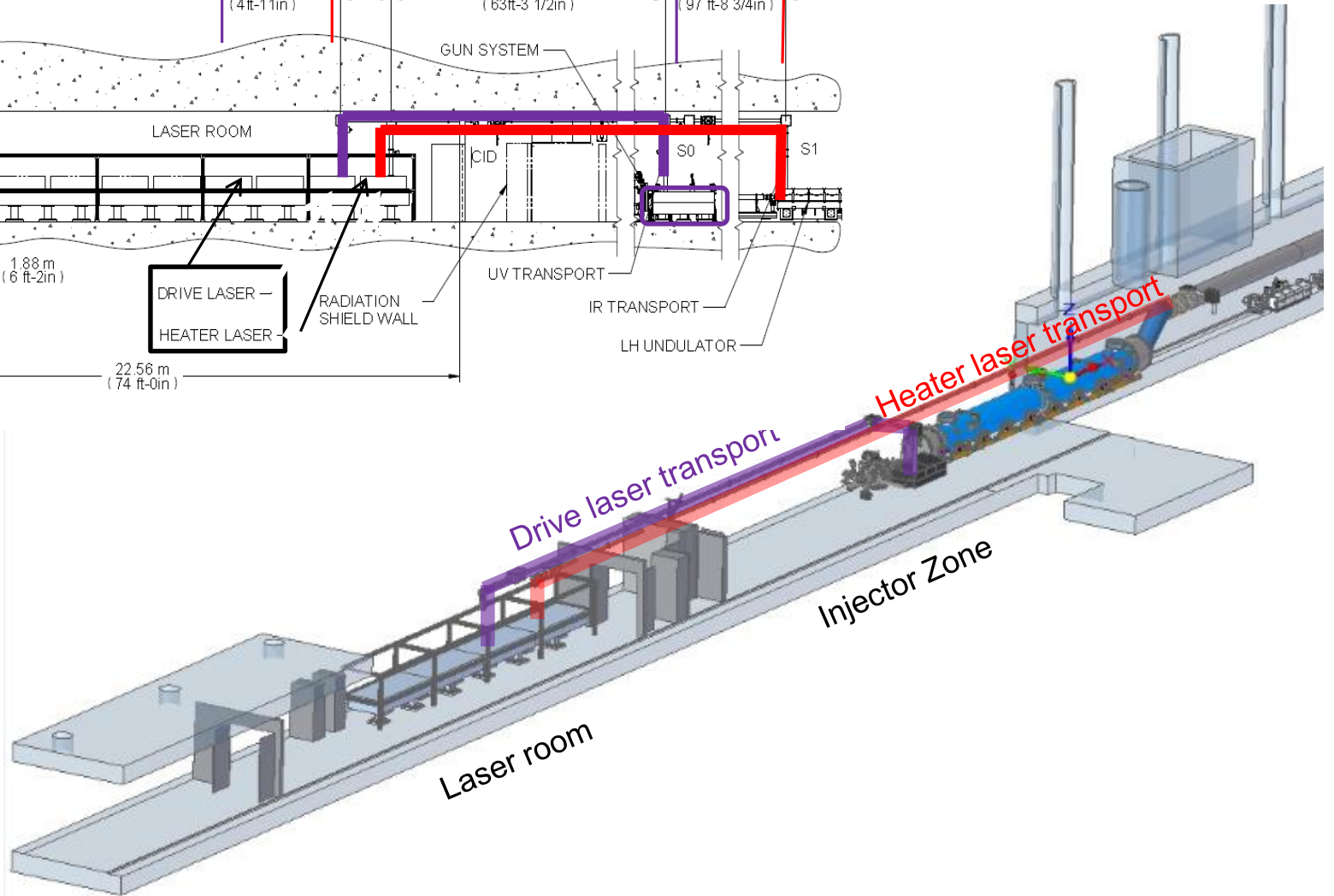
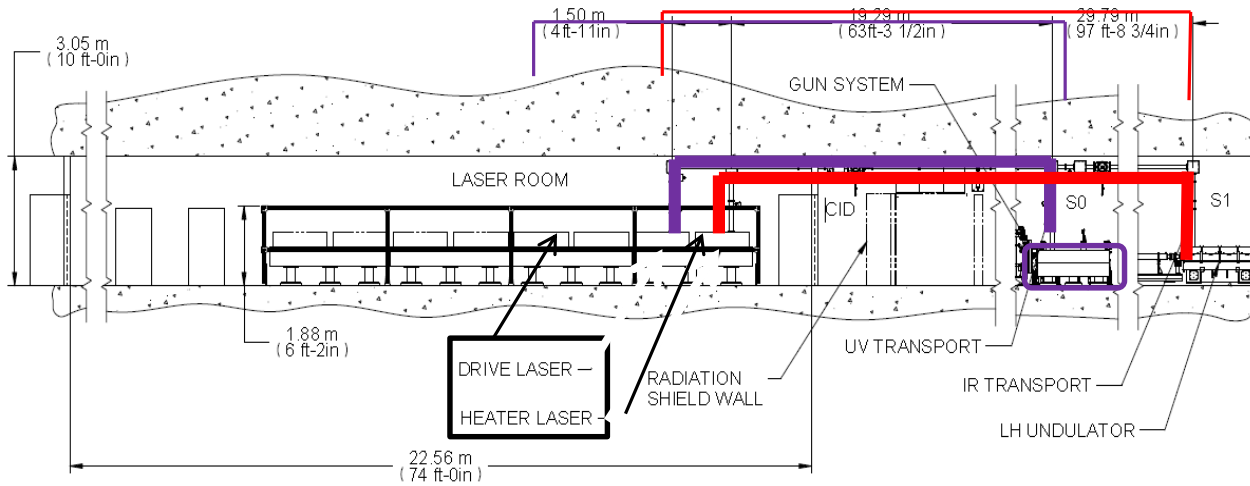
Interlock Status screen

Shutter Status screen

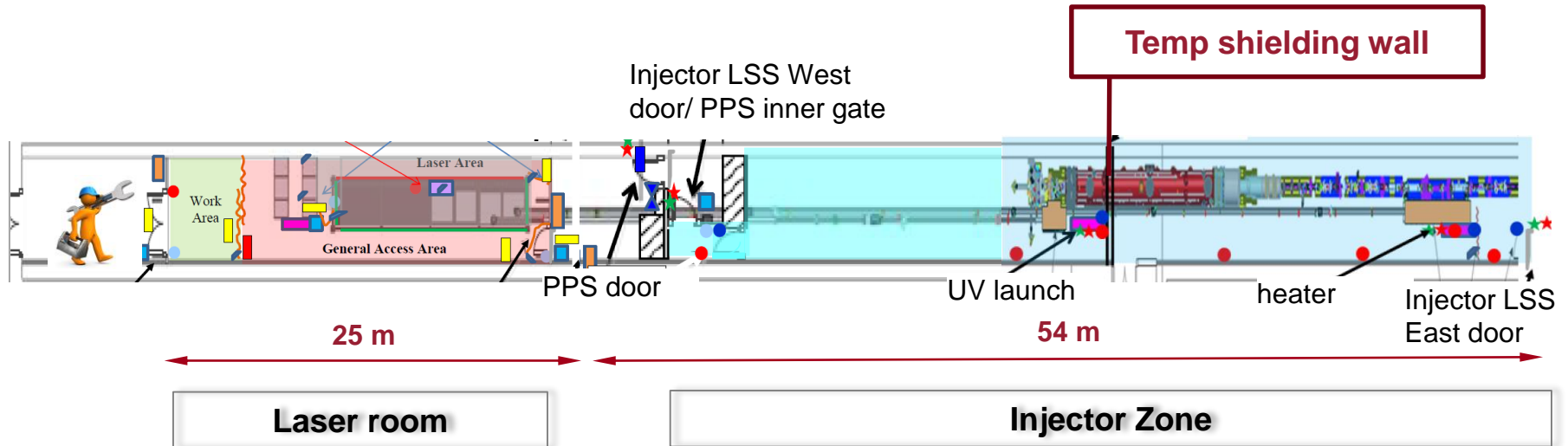
FACET-II Vault



LCLS-II Photo-injector - layout

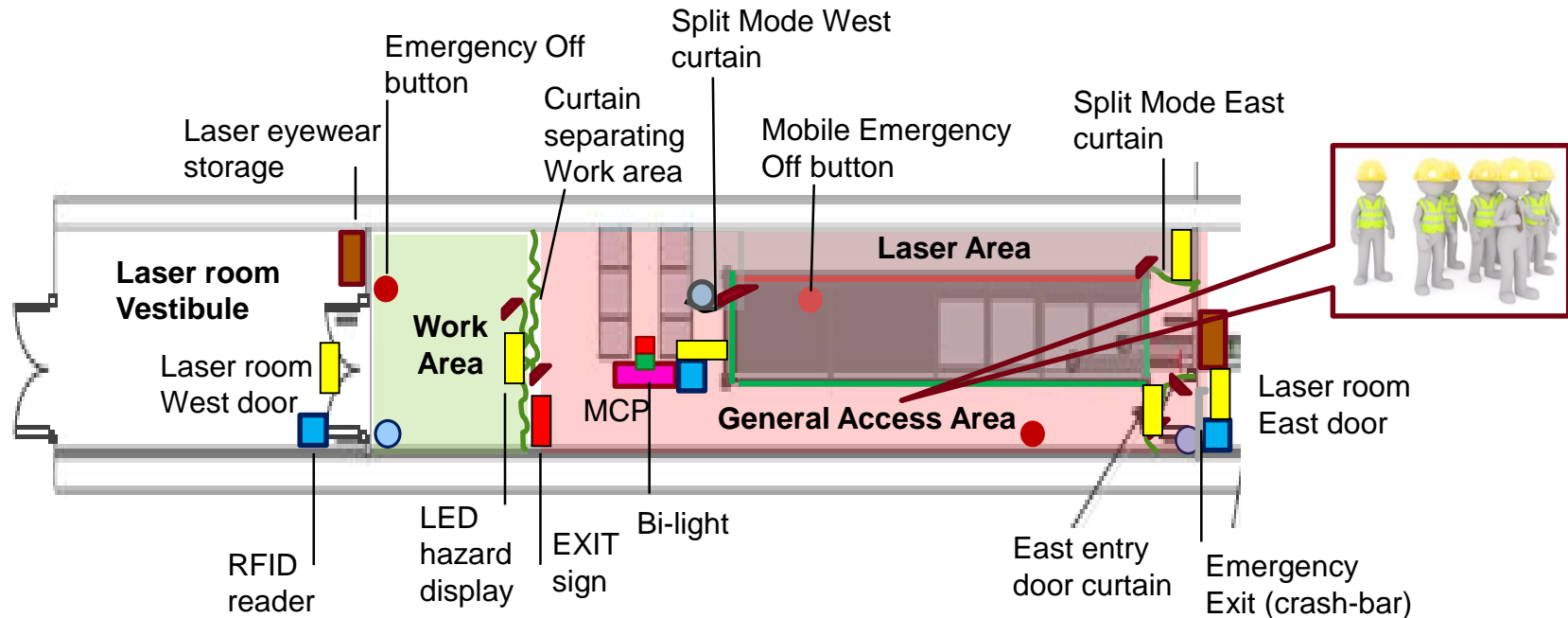


LCLS-II Laser System - layout



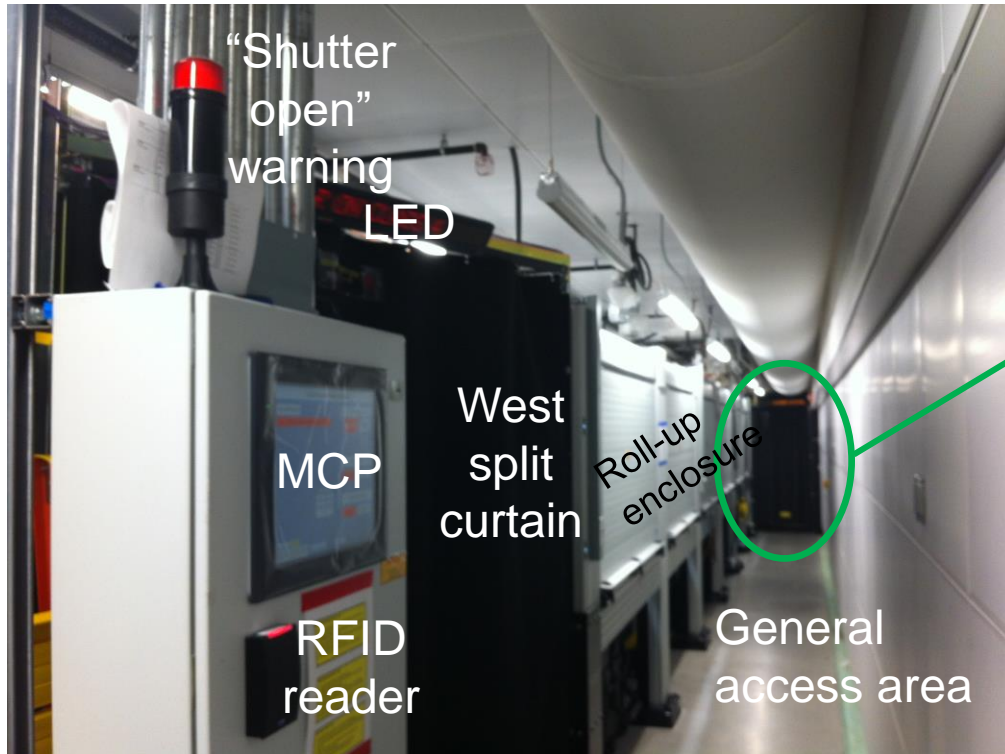
- ❑ Access to the gun area (Injector Zone) is through the laser room.
- ❑ **Split mode** of operation provides access of non-laser workers to the gun area in parallel with the laser work in Laser room.

LCLS-II – Laser Room Split Mode Operation



- Laser Area: Class 4 mode (laser eyewear required)
- General Access Area: Class 1 Operational mode (Laser Enclosed) - no eyewear
- Entry doors can be unlocked
- Interlocks:
 - South rollup doors for laser table closed
 - 2 split mode curtains closed
 - 2 rack doors closed

LCLS-II – Split mode



Administrative controls - Documents

- ❑ SOP/Contract (laser hazards and controls, including LSS specification)
- ❑ Initial Acceptance Test for LSS (IAT)
- ❑ Interface Control Document (ICD) for LSS-PPS Interface



**Standard Operating
Safety C**
Building 001, LC
LCLS-II



Stanford Linear Accelerator Center
Stanford Synchrotron Radiation Laboratory

Procedure Number: 262-100-45 Revision C00

Author: Sasha Gilevich
Department: LCLS LST
Location: Building 001, LCLS-II Injector and I


Date: TBD
Laboratory Phones: 1800, 1843

APPROVAL OF SOP AND LASER SAFETY C
DESCRIBED HEREIN:

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LCLS-II Injector Laser Roc

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Sasha Gilevich, System Laser S

Reviewed: _____

Safety Systems Department	PPS to LSS Interface Control and System Configuration Document (ICD)				
	DCONo.	Released By:	Effective Date	Document No.	Rev.
	0831	Reference Only	1 Mar 17	CD-SS-PPS-07-11-07	02

Printed copies of this document must be verified as being current prior to use by checking the effective date on the Safety Systems Document Master List.

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LCLS-II and FACET-II – Current status

- ❑ FACET-II:
 - Laser room fully approved for operations
 - Injector Vault: LSS validation and IAT underway
- ❑ LCLS-II:
 - Laser room fully approved for operations
 - Injector zone – September 2018

Thank you!

