

LCLS Engineering Specifications Document #	1.9-114	LUSI, CF, XES	Revision	0
Engineering Specifications for the CXI Room of the FEH LUSI Document # ESD SP-391-001-37				
Aymeric Robert Author, LUSI Scientist		Signature	Date	
Sébastien Boutet Author, LUSI Scientist		Signature	Date	
Hal Tompkins LCLS Photon Systems		Signature	Date	
John Arthur Photon Systems Manager		Signature	Date	
Javier Sevilla FEH Hutch Project Engineer		Signature	Date	
David Saenz LCLS CF System Manager		Signature	Date	
Richard M. Boyce LCLS System Manager		Signature	Date	
Darren Marsh Quality Assurance Manager		Signature	Date	
John Galayda Director, LCLS Construction		Signature	Date	

This document describes the requirements for the control cabin associated with experimental hutch #5 of the LCLS, located in the Far Experimental Hall (FEH). This control cabin will be used for the Coherent X-ray Imaging (CXI) instrument. This document will serve as a room data sheet for this room.

Change History Log

Rev Number	Revision Date	Sections Affected	Description of Change
000		All	Initial Version

PRELIMINARY

1. Physics Requirements

The CXI Room in the Far Experimental Hall (FEH) will house the control workstations for the Coherent X-ray Imaging (CXI) instrument. This section describes the justifications for the requirements listed in the rest of the document.

1.1. Room Dimensions

The CXI Room must be large enough to comfortably seat 5 users, each with a computer and free desk space. The length of the room needs to be shorter than the Hutch #5 to allow direct access to the hutch via the equipment door.

The room must be as close to 3 meters wide as possible while still allowing sufficient aisle space on the North side of the FEH.

1.2. Water Cooling

It is likely that one or more electronics racks will be needed in the control cabin. Water cooling, with 5 GPM per rack is required. A total of 10 GPM of process cooling water must be available at a single water drop inside the control cabin.

1.3. Temperature Control

Since most of the heat will be removed using water, the demands of the HVAC system will be smaller since very little heat will need to be removed. The HVAC requirements should be the same as that of the whole FEH. That is the cooling system of the FEH can be used to cool this room without a need for temperature control.

1.4. Compressed Air

No compressed air is required.

1.5. Telephone Lines

One phone jack is requested on each wall inside the control cabin.

1.6. Data Lines

Public data ports are needed for user-supplied devices. A private data network will be built by the Controls group for the control system. At least one data location is needed on every wall. Multiple ports (at least 2) are needed at each location.

1.7. Low Profile Conduits

All fixtures and conduits (lighting, electrical, HVAC, etc.) must be low profile in order to leave sufficient space for desks and shelves for users.

1.8. Doors

Due to the overall length of the control cabin, two access doors are requested. The doors should have (1ft²) windows.

1.9. Gases

No gas requirements

1.10. Walls

Users will supply their own equipment such as racks. These will be required to be secured to the walls in case of an earthquake. Provisions must be made for securing devices to walls in the future without requiring holes to be drilled in the radiation shielding. Extruded aluminum imbedded in the walls is the preferred solution but Unistrut is also an acceptable option.

1.11. Lighting

Indirect halogen lighting which is not too hard on the eyes is required for the control cabin. Also, in some cases, higher illumination levels will be required inside the control cabin and therefore, regular fluorescent lighting should also be provided.

1.12. Cable Trays

The lowest cable tray must be higher than 8 ft 6 inches in order for the racks to fit under them. The preference is for 1 ft wide cable trays. A single 1 ft wide tray is needed all the way around the room.

1.13. Ceiling

A drop acoustic ceiling is required to reduce the noise level.

2. Overview

- Name of Building: CXI Room
- Dimensions: Height: 13 feet
Width: 9 feet 4.9 inches
Length: 39 feet 2 inches
- Hours of Operation: 24 hours a day, 7 days a week and 365 days a year
- Users/Occupancy: 5 (non-occupied room with maximum occupancy of 5)

The experimental hutches and related rooms are being built for the Linac Coherent Light Source (LCLS) project at the Stanford Linear Accelerator (SLAC), a part of Stanford University, hereinafter referred to as the University.

The University requires that the Vendor be responsible for assurance that the hutches meet all the requirements of this specification. Inspection and approval of designs and documents by the University does not alter that responsibility in any way. No deviation from this specification or those stipulated herein shall be permitted without prior written permission by the University, including alternatives specified as "University Approved Equal."

When approval by the University is required, it is understood that the University refers to the LCLS project and specifically the Photon Systems group in consultation with the LCLS Ultrafast Science Instruments (LUSI) project.

3. Applicable Documents

3.1. SLAC Drawing

- a. SLAC Drawing LO-391-750-00, - "LUSI Integration Beam Line Layouts Master Beamline Schematic"
- b. SLAC Drawing MR-391-750-34, - "Hutch 5 Utilities"
- c. SLAC Drawing LO-391-750-38, - "LUSI Integration Conventional Facilities FEH Walls and Doors"
- d. SLAC Drawing LO-391-750-39, - "LUSI Integration Conventional Facilities FEH Stay-Clear Hutch & Util"
- e. SLAC Drawing LO-391-750-44, - "Hutch 5 Stay Clear Drawing"

4. Functional Objective

The CXI Room associated with Hutch 5 located in the Far Experimental Hall will be used to house the computer workstations used to control the Coherent X-ray Imaging instrument. It will be the location where users of the instrument are located during data collection and the room should therefore be reasonably comfortable and welcoming to users.

5. Building Orientation Requirements

- 5.1. Walls shall be parallel to FEH cavern, not parallel to the LCLS beam. The LCLS beam coordinates are defined on drawing LO-391-750-00.

6. Size Requirements

SLAC drawing LO-391-750-38 shows a recommended room layout and should be used as a guideline to meet the specifications in this document. The north and south walls are also defined in this drawing.

- 6.1.** The CXI Room shall be at least 30 ft long along the beam direction.
- 6.2.** The CXI Room shall be at least 9 ft wide in the direction perpendicular to the beam.
- 6.3.** The North wall of the CXI Room shall be located so that a sufficiently large aisle exists for equipment on the North side of the FEH.
- 6.4.** The South wall of the CXI Room shall be the North wall of the CXI Hutch #5.

7. General Requirements

- 7.1.** The CXI Room shall have a modular and flexible design to the extent possible that allows for future expansion or modification and shall follow the general layout shown in SLAC drawing MR-391-750-38. The walls of the control cabin shall not be load-bearing walls. If significant cost savings could be achieved by adding load bearing supports near the control cabin walls, these shall be communicated and approved by the University prior to the completion of Title 1 drawings.

8. Floor Requirements

- 8.1.** The floor shall be painted with durable grey epoxy floor paint that meets federal color standard FS16515. Alternative color shall be approved by the University.

9. Finishes Requirements

Walls

- 9.1. The walls shall be painted with a minimum of two coats of white flat paint meeting federal color standard FS27875. Alternative color shall be approved by the University.
- 9.2. The walls shall have a flexible (non-load bearing) design that allows for future expansion or modification.
- 9.3. Where a wall is shared between the CXI Room and Hutch #5, there shall be penetrations through the wall for cables. These penetrations shall not allow a direct line of sight for the X-rays to escape the hutch area and the design shall be approved by Radiation Physics. The location of the penetrations is shown on drawing LO-391-750-34. The details of the approved penetrations are shown in a drawing to be provided..
- 9.4. There shall be extruded aluminum frame or Unistrut surface-mounted on the walls that would allow equipment to be fixed to the wall (such as gas bottles for example) without requiring holes to be drilled into the wall. Such mounting structures shall be surface-mounted on the walls vertically at a regular 10 feet interval. The pieces of aluminum or unistrut shall extend from 3 ft to 8 ft height.

Ceiling

- 9.5. The ceiling shall be painted with a minimum of two coats of white flat paint meeting federal color standard FS27875. Alternative color shall be approved by the University.
- 9.6. The clear height of the room shall be 13 feet.
- 9.7. The ceiling height and the thickness of the ceiling shall not preclude the addition of a second floor to the FEH directly above the room. This second floor height shall be a minimum of 8 feet (ceiling). The second floor does not need to cover the entire room area. Due to the cylindrical shape of the Far Experimental Hall, the coverage of the second floor will be less than the first floor.
- 9.8. The dimensions of the second floor shall be maximized by minimizing the thickness of the structure supporting the second floor.
- 9.9. There shall be an acoustic mylar finish drop ceiling at a height of 10 feet.

10. Doors and Fenestrations

Doors

- 10.1. There shall be 2 doors to access the control cabin from the North side and the East side, as shown on drawing MR-391-750-38.
- 10.2. The doors shall allow 6 feet of entry space.
- 10.3. The doors shall be 7 feet high.
- 10.4. The North side door shall be directly in front of the door to Hutch #5.
- 10.5. The doors shall be painted with 2 coats of white paint that meets federal color standard FS27875. Alternative color shall be approved by the University.

Fenestrations

10.6. There shall be a window with a minimum viewing area of 1ft² on each of the doors.

11. Stay Clear Requirements

11.1. The stay clear areas for the CXI instrument and its associated equipment are defined in SLAC drawing LO-391-750-44. Any non-experimental structures, utilities, lighting, fire sprinklers, electrical panels, etc. shall be outside of this stay clear zone. Exceptions to the stay clear shall be approved by the University.

12. Acoustic Requirements

12.1. The CXI Room shall meet the NC35 acoustic standards.

12.2. There shall be an acoustic ceiling at a height of 10 feet.

13. Heating Ventilation and Air Conditioning (HVAC) Requirements

HVAC

13.1. There shall be a heating system and an air conditioning system capable of maintaining the temperature at 72 +/-5 degree Fahrenheit. Time stability at any given point is required while spatial fluctuations greater than 1 degree F are allowable. The HVAC system for the FEH can be used to ventilate the CXI Room.

13.2. The HVAC system shall provide clean air using pre-filters, high efficiency filters and HEPA filters in the air handling unit.

13.3. The HVAC ducts shall be located outside the room with penetrations through the roof of the room.

13.4. The HVAC inlet and outlet vents (registers) shall be located away from the interaction region between the LCLS beam and the sample so that air is not blown onto the sample area. A layout showing a proposed location of all ducting and registers is shown on drawing LO-391-750-34 and the final layout shall be approved by the University.

13.5. The relative humidity inside the room shall be controlled at 45%+/- 10%.

13.6. There shall be an adequate smoke detection/fire suppression system consistent with the relevant norms and regulations consisting of a wet sprinkler system and a smoke detector. A fire hazard analysis will be performed by SLAC.

14. Gas Requirements

14.1. None

15. Compressed Air Requirements

15.1. None

16. Communication Requirements

Telephone

- 16.1.** The phone cabling and conduits shall be attached as close to the wall or ceiling as possible to minimize unusable space. The proposed layout of the phone conduits are shown on drawing MR-391-750-34 and the final layout shall be approved by the University
- 16.2.** There shall be at least 1 phone location per wall located at a 4 ft height.
- 16.3.** The exact locations of the telephone jacks shall be provided by the LUSI group on drawing MR-391-750-34 and the final layout shall be approved by the University.

Data ports

- 16.4.** The Ethernet data cabling and conduits shall be attached as close to the wall or ceiling as possible to minimize unusable space. The proposed layout of the data conduits are shown on LUSI drawing MR-391-750-34 and the final layout shall be approved by the University.
- 16.5.** There shall be at least 1 data location per wall located at a 4 ft height.
- 16.6.** There shall be at least 2 data locations per wall located at a 4 ft height on the North and South walls.
- 16.7.** There shall be at least 2 data ports per location.
- 16.8.** The exact location of the data ports shall be provided by the LUSI group on drawing MR-391-750-34 and the final layout shall be approved by the University.

17. Plumbing/Fire Protection Requirements

Fire Protection

- 17.1.** There shall be at least 1 fire alarm pull station inside the room or whatever is prescribed by the fire hazard analysis.
- 17.2.** There shall be a smoke detection system linked to the fire suppression system.
- 17.3.** The fire suppression system shall be attached as close to the ceiling as possible to minimize unusable space. The proposed layout of the fire suppression system is shown on LUSI drawing MR-391-750-34 and the final layout shall be approved by the University.

Process Cooling Water

- 17.4.** Process cooling water shall be provided inside the CXI Room at 10 gallons per minute, 15 PSI and at 68 ± 2 degrees Fahrenheit.
- 17.5.** The supply and return process cooling water pipes shall each be terminated with a shut-off valve and pressure gauge at a height of 4 ft.
- 17.6.** The process cooling water shall include filtration which is easily accessible for routine maintenance.
- 17.7.** The piping for the process cooling water shall be attached as close to the wall as possible to minimize unusable space. The proposed layout of the process cooling water pipes, shut-off valves and pressure gauges is shown on LUSI drawing MR-391-750-34 and the final layout shall be approved by the University.
- 17.8.** A process cooling water point of use shall be located on the West wall of the room, at least, with possible other locations to be specified.

- 17.9.** The exact locations of the process cooling water points of use shall specified by the LUSI group on drawing MR-391-750-34 and the final layout shall be approved by the University.

18. Electrical Requirements

Power Supply

- 18.1.** There shall be 110 V, 1 phase, 20 Amps double duplex outlets located every 10 feet on all walls of the CXI Room at a height of 4 ft. These are the convenience outlets for tools, computers and other temporary equipment.
- 18.2.** 1 panel shall be provided with 120/208 volts, 3 phase power in the CXI Room. One panel shall be “clean” power and the second shall be “dirty” power. The proposed location is shown on drawing MR-391-750-34.
- 18.3.** The panel shall have a main breaker with a 100 Amp capacity.
- 18.4.** The transformers for all the power shall be located outside the room on the utilities platform area located above the hutches.
- 18.5.** The location of the panels shall be specified by the LUSI group on drawing MR-391-750-34 and the final layout shall be approved by the University.
- 18.6.** The panels shall be fixed to the wall directly and be as low profile as possible to minimize unusable space.
- 18.7.** The electrical distribution shall be ceiling-mounted with vertical points of use or mounted to the walls of the room. In either case, it shall not encroach on the stay clear areas to be defined by drawing LO-391-750-44 unless agreed upon by the University and it shall be as low profile as possible (attached directly to the wall or ceiling).

19. Cable Tray Requirements

- 19.1.** A single 1 foot wide cable tray shall be used all the way around the interior of the room.
- 19.2.** The cable trays and their mounting components shall be no lower than 8 feet 6 inches from the floor.
- 19.3.** The cable trays shall be electrically grounded.
- 19.4.** The cable trays shall be attached to the walls and mounted as close to the walls as possible to minimize unusable space. A proposed layout shall be provided by LUSI on drawing MR-391-750-34 and the final layout shall be approved by the University.
- 19.5.** An elevation drawing showing the desired location of the cable trays and utilities shall be provided by the LUSI group on drawing MR-391-750-34 and the final layout shall be approved by the University.

20. Lighting Requirements

- 20.1.** Light fixtures shall be provided to generate a lighting level of 50FC (foot candles).
- 20.2.** The CXI Room shall have indirect halogen lighting that is wall-mounted and regular fluorescent lighting that is ceiling mounted. The 2 lighting systems shall be independent.
- 20.3.** Light switches next to the CXI Room doors shall be provided.

- 20.4.** All fixtures shall be surface mounted. A proposed layout shall be provided by LUSI on drawing MR-391-750-34 and the final layout shall be approved by the University.
- 20.5.** All conduits shall be surface mounted to minimize unusable space. A proposed layout shall be provided by LUSI on drawing MR-391-750-34 and the final layout shall be approved by the University.
- 20.6.** No night lighting shall be required.
- 20.7.** It shall be possible to completely darken the room when required by the experiment.
- 20.8.** It shall also be possible to partially darken the room with the use of dimmer switches.
- 20.9.** There shall be an emergency lighting system provided.
- 20.10.** Emergency lighting per Life Safety Code and Engineering Standards shall be provided inside the room.

21. Radiation/Seismic Requirements

- 21.1.** All equipment (HVAC, cable trays, piping, panels, etc.) and systems shall be seismically braced and restrained per the requirements of 2007 Uniform Building Code and SLAC Seismic Safety.

22. Vibration Requirements

- 22.1.** None

23. Special Equipment Requirements

- 23.1.** None

24. Management Requirements

- 24.1.** Suggested routing of all utilities and conduits (phone, water, compressed air, lighting, fire suppression system, HVAC ducts and registers, power, electrical panels) shall be provided in drawings by the LUSI group to the Photon Systems Manager of LCLS.
- 24.2.** Any final specifications to be distributed to the Conventional Facilities group of LCLS and the FEH Hutch Project Manager shall be distributed to the LUSI group at least 2 days before so that the LUSI group can identify possible issues and discuss possible solutions with the Photon Systems group.

25. Applicable Standards

- 29 CFR Part 1910 Occupational Safety and Health Standards Dept of Labor
- 29 CFR Part 1926 Safety and Health Regulations for Constructions Dept of Labor
- Uniform Building Code (UBC) 1997 including appendixes
- National Electric Code (NEC) 2003
- Uniform Mechanical Code (UMC) 1997 including appendixes
- Uniform Plumbing Code (UPC) 1997 including appendixes
- Uniform Fire Code (UFC) 1997 including appendixes

- California Code of Regulations Title 8 Industrial Safety
- Title 19 Public Safety
- NFPA 70 National Fire Codes
- National electrical Safety Code ANSI C2
- Occupational Safety and Health Act (OSHA)
- General Services Administration 41 CFR part 101-19
- American with Disabilities Act (ADA)
- Environmental Protection Agency 40 CFR Parts 264 and 265
- SLAC Environmental Safety & Health Manual
- General Industrial Activities Storm Water Permit (SLAC Permit)
- NFPA 101 life Safety Code
- California Building Energy Efficiency Standards, Title 24
- DOE standard 10 CFR Part 435
- ASHRAE/IES Standards 90.1
- NFPA Standard 13 and SLAC Fire Marshall requirements
- LCLS Cabling Standard
- SLAC LOTO
- 2007 Uniform Building Code