

<b>LCLS Engineering Specifications Document #</b> 1.9-116	<b>LUSI, CF, XES</b>	<b>Revision</b> 0
<b>Engineering Specifications for the Common Room of the FEH</b> LUSI Document # ESD SP-391-001-40		
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This document describes the requirements for a common laboratory room located in the Far Experimental Hall (FEH). This room will be located between the Coherent X-ray Imaging (CXI) and X-ray Correlation Spectroscopy control cabins and it will be used, among other things, for sample preparation by all users of the FEH. 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 common room in the FEH will be used to house small sample preparation and characterization devices and possibly lasers. This section describes the justifications for the requirements listed in the rest of the document.

### 1.1. Room Dimensions

The top priority on the FEH ground floor is to provide sufficient space for the instruments inside the hutches. The second priority is to provide enough control room space for users to comfortably perform their experiments. With this two criteria satisfied, if there's any space left in the ground floor, it is crucial to provide a laboratory area where users can set up their equipment and prepare samples. Space should be available between the CXI Room and the XCS Room and all this space should be used for the common laboratory.

This laboratory may also be used, in the absence of a second floor in the FEH as a laser laboratory. The room is required to be large enough for at least a 4x8 ft laser table with 3 ft of clearance all the way around for the experimenters for a total area of 10x14 ft.

### 1.2. Water Cooling

Process cooling water will possibly be used for various equipment. A supply of 10 GPM for various uses is required. On top of that, there should be sufficient process cooling water available in the common laboratory to cool a laser system requiring 10 GPM of process cooling water. Therefore a total a 20 GPM should be provided to the common laboratory.

Chilled water (44 degrees Fahrenheit) will not be used directly. However, there should be a sufficient supply of chilled water to allow for the addition of a heat exchanger if the supply of process cooling water becomes insufficient.

### 1.3. Temperature Control

In the event of the common laboratory space being used for a laser, temperature gradient becomes critical. Since most of the heat will be removed using water, the demands on the HVAC system will be small since very little heat will need to be removed. Temperature gradients throughout the room are acceptable (for example warmer air near the ceiling) provided each is stable to within the  $\pm 1$  degree Fahrenheit tolerance.

The air speed inside the room must be minimized due to the possibility of performing measurements in air. Low air flow while meeting the temperature stability requirements is typically achieved with large ducts. These large ducts should not be located inside the room since they could preclude the use of a ceiling-mounted crane. The ducts should be located on the roof of the room with penetrations through the ceiling. The duct penetrations must be away from sensitive equipment in order to prevent temperature fluctuations.

### 1.4. Compressed Air

Compressed air may be required for some devices in the laboratory and one air drop should be provided inside the laboratory.

### **1.5. Telephone Lines**

Communication between users inside the common laboratory and an operator at the control station inside the control cabin may be required. Phone lines are needed for that purpose. One phone jack is requested inside the room.

### **1.6. Data Lines**

Public data ports are needed for user-supplied devices. They are also needed for connecting temporary workstations. 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 the overhead crane.

### **1.8. Doors**

The doors to the common lab cannot have a window in it due to the possible use of the room as a laser laboratory. A double wide door is needed for equipment. A single wide door is also needed for the possible addition of a vestibule inside the room for laser safety reasons.

### **1.9. Gases**

Many experiments are foreseen to require gases. Some of the equipment inside the laboratory may require gas bottles. A gas cabinet is required to hold all gas bottles that will be used in the laboratory.

### **1.10. Walls**

Users will supply their own equipment such as racks. These may 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**

The lighting level inside the common laboratory must be higher than normal since users are expected to work with lasers that require dark eye protection. Also, when working with the lasers, it may be necessary to completely or partially darken the room. Dimmers or lighting on separate switches is required.

### **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 total of two 1 ft wide trays are needed all the way around the room. The preference is a stacked arrangement of 2 trays vertically.

### **1.13. Ceiling**

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

## 2. Overview

- Name of Building: FEH Common Room
- Dimensions: Height: 13 feet  
Width: 24 feet 3 inches  
Length: 16 feet 5.3 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 LO-391-750-46, - "Common Room 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-391-750-45, - "Common Room Stay Clear Drawing"

## 4. Functional Objective

An area for users to set up test equipment and prepare samples or assemble equipment that will be used during an experiment is required to be located near the experimental hutches. The common room will serve this purpose. It will house standard laboratory workbenches available for all users of the FEH.

## 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 common room shall be at least 26 feet long in the beam direction and fit between the CXI Room and XCS Room.
- 6.2. The North wall of the common room shall be located so that a sufficiently large aisle exists for equipment on the North side of the FEH. The North wall shall be the same distance from the North wall of the FEH as the CXI Room and XCS Room.
- 6.3. The South walls of the common room shall be the North walls of Hutches 4 and 5.

## 7. General Requirements

- 7.1. The room shall have a flexible design to the extent possible that allows for future expansion or modification, without major financial impact and shall follow the general layout shown in SLAC drawing LO-391-750-38. The walls of the room shall not be load-bearing walls. If significant cost savings could be achieved by adding load bearing supports near the room 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. There shall be penetrations through the walls shared with hutches 4 and 5 for cables. These penetrations shall not allow a direct line of sight for the X-rays or laser light to escape the hutch area and the design shall be approved by Radiation Physics. The location of the penetrations is shown on drawing LO-391-750-46. The details of the approved penetrations are shown in a drawing to be provided.
- 9.4. Penetrations shall also exist from the common room to the CXI Room and XCS Room as shown on drawing LC-391-750-46. These penetrations do not need to be approved by radiation physics but they shall not allow light to propagate out of the common laboratory area since it may be used to house laser.
- 9.5. 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

- 9.6. 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.
- 9.7. The clear height of the room shall be 13 feet.
- 9.8. 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.
- 9.9. The dimensions of the second floor shall be maximized by minimizing the thickness of the structure supporting the second floor.
- 9.10. 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 swinging doors to access the room opening on the aisle way of the FEH.
- 10.2. The doors shall allow a 7 feet high entry.
- 10.3. The first door width shall allow 72 inches of entry space.
- 10.4. The second door width shall allow 36 inches of entry space.

- 10.5.** The door shall open a passage from the Common Room onto the FEH as shown on drawing LO-391-750-38.
- 10.6.** The doors shall be light tight.
- 10.7.** The door shall be painted with 2 coats of white paint that meets federal color standard FS27875. Alternative color shall be approved by the University.

### **Fenestrations**

- 10.8.** No windows are allowed due to the possible use of the room as a laser laboratory.

## **11. Stay Clear Requirements**

- 11.1.** The stay clear areas for the FEH room and its associated equipment are defined in SLAC drawing LO-391-750-45. 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 Common 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 +/-1 degree Fahrenheit. Time stability at any given point is required while spatial fluctuations greater than 1 degree F are allowable.
- 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 air flow velocity in the room shall be minimized to prevent air currents while still maintaining the temperature stability of Requirement 13.1.
- 13.4.** The HVAC system, including the ducts shall have minimal direct contact with the room structure and walls in order to prevent the propagation of vibrations from the HVAC system to the experimental area. The floor vibrations inside the room induced by the HVAC system shall meet the requirements of Section 22.
- 13.5.** The HVAC ducts shall be located outside the room with penetrations through the roof of the room.
- 13.6.** The HVAC inlet and outlet vents (registers) shall be located as shown on drawing LO-391-750-46 and the final layout shall be approved by the University.
- 13.7.** There shall be temperature sensors located inside the room to interface with the Direct Digital Control (DDC) system that controls the HVAC system. The proposed location of the sensors is shown on SLAC drawing LO-391-750-46.
- 13.8.** The relative humidity inside the room shall be controlled at 45%+/- 10%.



- 13.9.** 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.

### **Direct Exhaust System**

- 13.10.** There shall be a direct exhaust system with a capability of 500 cubic feet per minute at 1.5" W.C. external static pressure in the common room.
- 13.11.** The exhaust system shall use a separate fan for each LCLS room.
- 13.12.** The location of the intake of the exhaust system is shown on drawing LO-391-750-46 and the final layout shall be approved by the University.

## **14. Gas Requirements**

- 14.1.** No centralized N<sub>2</sub> gas system will be provided in the FEH.
- 14.2.** A local distribution network within the room shall be provided for the use of gas bottles. Details of this network are to be provided by LUSI on drawing LO-391-750-46 and approved by the University.
- 14.3.** A gas cabinet shall be located inside the room to contain the gas bottles. The location of the gas cabinet shall be provided by LUSI on drawing LO-391-750-46 and approved by the University.

## **15. Compressed Air Requirements**

- 15.1.** The compressed air piping shall be attached as close to the wall as possible to minimize unusable space. The proposed layout of the compressed air lines are shown on LUSI drawing LO-391-750-46 and the final layout shall be approved by the University.
- 15.2.** The compressed air shall be clean, dry and oil-free at 10 cubic feet per minute and 100 psig.
- 15.3.** The compressed air points of use shall be located on the South wall of the room at a height of 4 ft.
- 15.4.** The proposed locations of the compressed air points of use shall be specified on drawing LO-391-750-46 and the final locations shall be approved by the University
- 15.5.** There shall be 1 shut off valve in the room.
- 15.6.** There shall be 1 pressure gauge in the room located close to one of the points of use.

## **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 LO-391-750-46 and the final layout shall be approved by the University
- 16.2.** There shall be at least 1 phone location on the North 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 LO-391-750-46 and the final layout shall be approved by the University.

**16.4.** The penetrations for the cabling shall be light-tight for future use of the room as a laser laboratory.

### **Data ports**

**16.5.** 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 LO-391-750-46 and the final layout shall be approved by the University.

**16.6.** There shall be at least 1 data location per wall located at a 4 ft height.

**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 LO-391-750-46 and the final layout shall be approved by the University.

**16.9.** The penetrations for the cabling shall be light-tight for future use of the room as a laser laboratory.

## **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 LO-391-750-46 and the final layout shall be approved by the University.

### **Process Cooling Water**

**17.4.** Process cooling water shall be provided inside the room at 20 gallons per minute, 15 PSI and at  $68 \pm 2$  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 LO-391-750-46 and the final layout shall be approved by the University.

**17.8.** A process cooling water point of use shall be located on the South 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 LO-391-750-46 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 room at a height of 4 ft. These are the convenience outlets for tools and other temporary equipment.
- 18.2.** 1 panel shall be provided with 120/208 volts, 3 phase power the room. One panel shall be “clean” power and the second shall be “dirty” power. The proposed location is shown on drawing LO-391-750-46.
- 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 panel shall be specified by the LUSI group on drawing LO-391-750-46 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-391-750-45 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.** Cable trays totaling 2 feet in width shall be installed along every wall all the way around the interior of the room. Two 1-foot wide trays shall be used in a vertical arrangement.
- 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 LO-391-750-46 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 LO-391-750-46 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 75FC (foot candles). This level is higher than normal due to the dark laser protective goggles worn by the personnel.
- 20.2.** All fixtures shall be low profile and surface mounted to minimize unusable space. A proposed layout shall be provided by LUSI on drawing LO-391-750-46 and the final layout shall be approved by the University.
- 20.3.** All conduits shall be surface mounted to minimize unusable space. A proposed layout shall be provided by LUSI on drawing LO-391-750-46 and the final layout shall be approved by the University.
- 20.4.** No night lighting shall be required.
- 20.5.** It shall be possible to completely darken the room when required by the experiment.

- 20.6.** It shall also be possible to partially darken the room with the use of dimmer switches.
- 20.7.** Light switches next to the room doors shall be provided both inside the room.
- 20.8.** There shall be an emergency lighting system provided.
- 20.9.** 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.
- 21.2.** Details for a preferred wall penetration shall be provided on drawing at a later date and final approval will be required by the University. This penetration scheme or the agreed upon solution shall be approved by Radiation Physics.

## 22. Vibration Requirements

- 22.1.** The floor vibrations shall be less than 1 micron/sec in the vertical direction.
- 22.2.** The floor vibrations shall be less than 0.5 micron/sec in the horizontal direction.
- 22.3.** Equipment to be provided by Conventional Facilities shall not induce vibrations larger than the specifications of requirements 22.1 and 22.2.

## 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