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Engineering Specifications for Hutch 5 of the FEH

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

Change History Log

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

1. Physics Requirements

Hutch #5 in the Far Experimental Hall (FEH) will house the Coherent X-ray Imaging (CXI) instrument. This section describes the justifications for the requirements listed in the rest of the document.

1.1. *Hutch Dimensions*

The CXI instrument will use two sets of KB mirrors with focal lengths of 8 and 0.7 meters respectively. Diagnostic devices upstream of the first set of mirrors require 2 meters of space. This places the interaction region at 10 meters inside the hutch. The sample to detector distance needs to be varied from 50 mm up to 2.5 meters in order to appropriately oversample the diffraction pattern of a wide range of particle sizes. The distance of 2.5 meters will allow a 1 micron object to be oversampled by a factor of 1.7, which is barely sufficient for imaging.

The CXI detector will have a hole in the middle and a second detector will be used to measure the low angle diffraction that passes through the hole. This second detector will also be used to characterize the focus of the beam. Both of these applications require the second detector to be placed far behind the focal plane in order for the direct beam to be large enough to be accurately sampled. Using the first set of mirrors, the X-ray beam will only be 0.5 mm wide 8 meters downstream of the sample. Using a single tile of the CXI detector, this means the beam is only 5 pixels wide, which is insufficient. Another detector with smaller pixels would help but such detectors either lack the 120 Hz repetition rate or the high dynamic range. The distance behind the sample must be maximized. Given the space constraints in the FEH, a distance of 10 meters downstream of the sample was chosen. A total length of roughly 20 m is required.

Only the North side of the beamline is useable by the CXI instrument due to the presence of a beam transport line going to Hutch 6. Therefore sufficient space must be available on the North side of the beamline. The width of all the CXI devices is fairly small since all the measurements will be in-line with the beam. The widest device is on the order of 1.5 meters wide and protrudes away from the beam towards the North by roughly 1 meter.

Space is required on the North side for users, racks, a laser table and a loading area for the crane. Therefore, at least 3 meters of space must exist between the beam axis and the North wall of the hutch.

Racks will be placed on the South side of the beamline. Because of fire safety issues, a separate room on the South side cannot be built and the South wall of the hutch should be the FEH cavern wall and left exposed as built.

Plans for the CXI instrument involve a ceiling-mounted 1-ton crane in direction of the LCLS beam. The crane will be used to move expansion spools of the detector stage and the detector stage itself. It will also be used to remove large vacuum chambers such as the 2 KB mirror chambers. Due to the large distances between devices, a single jib crane will not be sufficient. Also, the CXI instrument will require a raised floor (not part of the scope of this

document) on the South side of the beamline and this will make impossible the use of an A-frame.

The height of the hook of the crane should be high enough to allow a large chamber (1 meter high) to be moved over the beamline (at 1.4 meters high). The height of the hook should be at no less than 10 ft high. In this case, higher is better. However, due to the lack of space in the FEH, a future second floor would be of great importance and it is necessary to keep the ceiling of the hutch as low as possible in order to leave sufficient space for a second floor. Therefore, a ceiling height of 13 ft was chosen to allow the use of a crane inside the hutch while allowing for a second floor to be added at a later date.

1.2. *Water Cooling*

The majority of the heat generated inside the hutch is expected to come from electronics such as motor controllers and power supplies. Water cooled racks will be used to remove all this heat. Each rack will be able to remove up to 8kW of heat and will require 5 gallons per minute of process cooling water at 68 degrees Fahrenheit. The CXI instrument is expected to require 5 racks for a total of 25 GPM of process cooling water. On top of that, an extra 10 GPM is needed for miscellaneous use by the users and possibly for detector cooling. Therefore a total of 35 GPM is required inside the hutch. Water cooling will be needed over the entire length of the hutch and three water points of use are required along the South wall.

Chilled water (44 degrees Fahrenheit) will not be used directly by the CXI instrument. 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*

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. Some of the CXI devices will be required to have good temperature stability in order to maintain their alignment. The two sets of KB mirrors for example require very accurate pointing. The temperature inside the hutch must be controlled to within $\pm 1^{\circ}$F to keep these devices stable. Temperature gradients throughout the hutch are acceptable (for example warmer air near the ceiling) provided each is stable to within the ± 1 degree Fahrenheit tolerance.

The air speed inside the hutch 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 hutch since they could preclude the use of a ceiling-mounted crane. The ducts should be located on the roof of the hutch, on the South side, 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 is needed for actuating up to 8 valves as well as multiple pneumatically driven diagnostic devices. Compressed air will be needed over the entire length of the hutch and multiple air points of use are required along the South wall.

1.5. *Telephone Lines*

Communication between users inside the hutch and an operator at the control station inside the control cabin is required during alignment of the experiment. Phone lines are needed for that purpose. One location is requested on the North wall inside the hutch.

1.6. *Data Lines*

Public data ports are needed for user-supplied devices. They are also needed for connecting temporary workstations during maintenance or installation. 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 main access to the hutch must be through the control cabin for rapid access to the experiment by the users.

Large equipment will from time to time be moved into the hutch and a large equipment door is needed. This door should not be through the control cabin so as to avoid the necessity of passing through 2 doors to access the hutch.

1.9. *Gases*

Many experiments are foreseen to require gases. The CXI particle injector itself requires CO2 and N2. A gas cabinet is required to hold all gas bottles that will be used by the instrument. This gas cabinet must be located on the North side of the beamline and the Northwest corner is most appropriate since it is away from critical components and the access doors to the hutch.

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*

The lighting level inside the hutch 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 hutch. Dimmers or lighting on separate switches is required.

1.12. *Cable Trays*

The lowest cable tray and its support 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 hutch. The preference is a stacked arrangement of two 1 ft wide trays vertically.

2. Overview

- Name of Building: FEH Hutch 5
- Dimensions: Height: 13 feet
  Width: 27 feet 4.6 inches
  Length: 65 feet 7.1 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 & Utl"

e. SLAC Drawing LO-391-750-44, - “Hutch 5 Stay Clear Drawing”

4. Functional Objective

Hutch 5 located in the Far Experimental Hall will be used to house experimental equipment for the Coherent X-ray Imaging instrument. Housing this equipment in a radiation tight and laser tight environment is the sole purpose of this hutch and the requirements of the instrument should be the driving force behind all the design decisions of the hutch. The

design of the hutches shall be fully consistent with the presence of a potential future second floor in the FEH as well as the presence of a crane attached to the support structure of the ceiling inside the hutch. The roof of the hutch shall constitute the floor of the second level. The hutch shall be considered as non-occupied space for fire safety purposes.

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 hutch 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. FEH Hutch 5 shall be at least 19.5 meters long along the beam direction.

6.2. The North wall of the hutch shall be no closer than 3 meters from the LCLS beam line at any point inside the hutch, while satisfying Requirement 5.1.

6.3. The South wall of the hutch shall be no closer than 1.5 meters from the LCLS beam line at any point inside the hutch, while satisfying Requirement 5.1. In practice, the South wall must be the FEH cavern South wall and shall be used as is and left uncovered.

7. General Requirements

7.1. The hutch shall allow the instrument located in it to be fully functional regardless of the status of the other LCLS hutches. Each LCLS hutch shall be capable of independent operations.

7.2. The hutch 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 hutch shall not be load-bearing walls. If significant cost savings could be achieved by adding load bearing supports near the hutch 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 and layout of the hutch shall allow the future addition of a raised floor no higher than 6 inches. The raised floor stay-clear is shown on drawing MR-391-750-34.

8.2. 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. The walls shall provide adequate radiation protection for users outside the hutch consistent with the requirements outlined in document RP-RPG-080606-MEM-01. The South wall does not require additional shielding.

9.4. There shall be penetrations through the wall 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 MR-391-750-34. The details of the approved penetrations are shown in a drawing to be provided..

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 hutch 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 hutch. This second floor height shall be a minimum of 8 feet (ceiling). The second floor does not need to cover the entire hutch 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. The support structure of the ceiling shall allow a 1-ton crane to be anchored to it. See SLAC drawing MR-391-750-34 for crane location.

10. Doors and Fenestrations

Doors

10.1. There shall be 1 sliding door to access the hutch opening on the outside of the hutch. The door shall open from right to left when standing outside the hutch.

10.2. The door shall run in a groove.

10.3. The door shall allow a 7 feet high entry.

10.4. The door width shall allow 44 inches of entry space.

10.5. The door shall interface with the Personnel Protection System (PPS).

10.6. The door shall open a passage from Hutch 5 into the CXI Room as shown on drawing LO-391-750-38.

10.7. The door locking mechanism shall be electronic with no physical key needed to access the hutch.

10.8. The door shall be painted with 2 coats of red paint that meets federal color standard FS11140. Alternative color shall be approved by the University.

Equipment Door

10.9. There shall be an equipment door, which is expected to be opened only occasionally, that will allow large equipment to enter the hutch.

10.10. The equipment door shall allow for a 10 feet wide and 8 feet high entry.

10.11. The equipment door shall be a roll-up door approved by Radiation Physics.

10.12. The entry into the hutch through the equipment door shall not be through the CXI Room, nor shall it be through the adjacent hutches and it shall be located as shown on drawing LO-391-750-38.

10.13. The equipment door shall be painted with 2 coats of red paint that meets federal color standard FS11140, provided the paint does not interfere with the proper functions of the door. Alternative color shall be approved by the University.

Fenestrations

10.14. There shall be a leaded glass viewing area of $2ft^2$ located in the sliding door. The thickness and material of the glass shall require approval from the Radiation Physics group and will be specified at a later date.

11. Stay Clear Requirements

11.1. The stay clear areas for the CXI instrument and its associated equipment are defined in SLAC drawing MR-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. None.

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 hutch 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 hutch structure and walls in order to prevent the propagation of vibrations from the HVAC system to the experimental area. The floor vibrations inside the hutch 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 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 MR-391-750-34 and the final layout shall be approved by the University.

13.7. There shall be temperature sensors located inside the hutch 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 MR-391-750-34.

13.8. The relative humidity inside the hutch 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 for each experimental hutch.

13.11. The exhaust system shall use a separate fan for each LCLS hutch.

13.12. The location of the intake of the exhaust system is shown on drawing MR-391-750-34. and the final layout shall be approved by the University.

14. Gas Requirements

14.1. No centralized N_2 gas system will be provided in the FEH.

14.2. A local distribution network within the hutch shall be provided for the use of gas bottles. Details of this network are to be provided by LUSI on drawing MR-391-750-34 and approved by the University.

14.3. A gas cabinet shall be located inside the hutch to contain the gas bottles. The location of the gas cabinet shall be provided by LUSI on drawing MR-391-750-34 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 MR-391-750-34 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 hutch at a height of 4 ft.

15.4. The proposed locations of the compressed air points of use shall be specified on drawing MR-391-750-34 and the final locations shall be approved by the University

15.5. There shall be 1 shut off valve per hutch.

15.6. There shall be 1 pressure gauge per hutch 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 MR-391-750-34 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 MR-391-750-34 and the final layout shall be approved by the University.

16.4. The penetrations for the cabling shall be radiation shielded.

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 MR-391-750-34 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 MR-391-750-34 and the final layout shall be approved by the University.

16.9. The penetrations for the cabling shall be radiation shielded.

17. Plumbing/Fire Protection Requirements

Fire Protection

17.1. There shall be at least 1 fire alarm pull station inside the hutch 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 each hutch at 35 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 South wall of the hutch, 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 a 208V, 3 phase, 30 Amps outlet inside the hutch at a height of 4 ft The proposed location is shown on drawing MR-391-750-34.

18.2. There shall be 110 V, 1 phase, 20 Amps double duplex outlets located every 10 feet on all walls of the hutch at a height of 4 ft. These are the convenience outlets for tools and other temporary equipment.

18.3. There shall be 208 V, 3 phase, 30 Amps panel for powering the overhead crane. The proposed location is shown on drawing MR-391-750-34.

18.4. 2 panels shall be provided with 120/208 volts, 3 phase power in each hutch. One panel shall be "clean" power and the second shall be "dirty" power. The proposed location is shown on drawing MR-391-750-34.

18.5. Each panel shall have a main breaker with a 100 Amp capacity.

18.6. The transformers for all the power shall be located outside the hutch on the utilities platform area located above the hutches.

18.7. 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.

18.8. The panels shall be fixed to the wall directly and be as low profile as possible to minimize unusable space.

18.9. The electrical distribution shall be ceiling-mounted with vertical points of use or mounted to the walls of the hutch. 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. Cable trays totaling 2 feet in width shall be installed along every wall all the way around the interior of the hutch. 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 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 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 MR-391-750-34 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 MR-391-750-34 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 hutch door shall be provided both inside and outside the hutch.

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 hutch.

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. An overhead electrical bridge crane (Model to be specified at a later date) with a 1 ton capacity shall be provided with a hook height of 10 feet at the top of its range. The crane shall run directly over the entire beamline inside the hutch and have an accessible loading area inside the hutch. The crane coverage is shown on drawing MR-391-750-34.

23.2. The crane would preferably be ceiling mounted but a pillar mounted crane is acceptable provided the pillars do not encroach on the defined stay-clear areas shown on drawing MR-391-750-34.

23.3. If a crane described in Requirement 23.1 cannot be provided, then the design of the hutch structure and walls shall not preclude the addition at a later time of a crane that meets these specifications.

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