Stanford Linear Accelerator Center
Stanford Synchrotron Radiation Laboratory

LCLS Room Data Sheet #	1.9-1010	Undulator Hall - Overall	Revision 2

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REVISION INFORMATION

Rev 2. Added LCLS ESD 1.9-102, ESD 1.9-103 and ESD 1.9-104, general changes, figures No. 2 and No. 3, added compressed air and outlets locations, cable trays specifications

ROOM DATA SHEETS

FACILITY COMPONENT

5.3 UNDULATOR HALL - ROOM DATA SHEET

Name of Building	Undulator Hall-Underground Tunnel			
Organization or Department	SLAC, Stanford University			
Net area	829	m^2	8924	sf
Critical dimensions	**H:**	4.5	m	14'-6"
	W:	4.9	m	16'
	L:	170	m	557'-9"
Hours of operation	Facility is locked 24/7/365 (periodic maintenance only)			
Users/Occupancy	No occupancy throughout the year when beam is ON			
Building orientation	Building to follow accelerator beamline - generally east west. The whole of this buidling is underground. Building is contiguous with the BTH and the Beam Dump hall.			

FUNCTIONAL OBJECTIVE

The Undulator Hall will house and provide a thermally and mechanically stable environment for a long line of undulator magnets and associated beamline equipment.

PLANNING CONSIDERATIONS & CRITICAL FACTORS

Relation to service buildings: Vertical penetrations 24 inch in diameter, must be designed to connect cables and utilities from service buildings on the surface to the equipment in the Undulator Hall. One of penetrations will be used for one time use for survey and alignment. Approximately 8 vertical will be required and the disposition should be to keep the cable lengths less than approximately 150 ft.

Vibration: If necessary, provide mitigation of sources of vibration of the undulator hall foundation,
especially due to adjacent vehicular traffic, and due to large reciprocating mechanical equipment.
The vibrations levels should at no point in the UH exceed 1 µm rms integrated over frequencies
greater than 1 Hz.

General

This is a tunneled structure and should have a uniform cross section throughout its length. Differential settlement of the floor is a critical factor to minimize. The Hall must follow the accelerator beam line precisely. Provision for a second beamline, parallel to the first, should be inlcuded in the deisgn. Access will be from the BTH and the Beam Dump halls only.

Access: Provision for transport of items of size up to 4 ft by 4 meters is required. These items will go through the access chicane in the BTH and the thermal barrier doors. Also objects of size up to 1 ft diameter by 20 ft long must be transportable into the Undulator Hall from the BTH. Access through the thermal barrier from the Beam Dump Hall is also required. For this access the maximum transported object size is 4 ft by 8 ft.

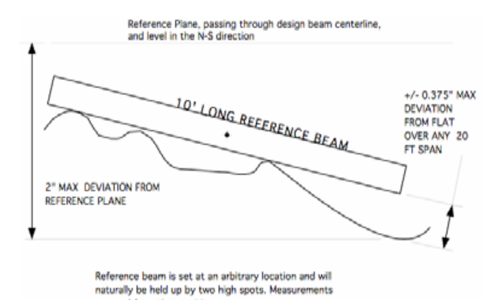
Construction Tolerances

The section of the tunnel surfaces between the floor (invert) and the ceiling, (if there is one) will be used to mount utilities, conduit, and alignment targets. A system of heavy duty unistrut embedded into the walls is required for supporting these elements. The embedded unistrut will be flush with the tunnel surface as required by the manufacturer. For tolerance on the straightness of the tunnel surfaces refer to LCLS ESD 1.9-102 Generic Accelerator Tunnel Construction Tolerance Specification

The tunnel walls may curve in the vertical direction by design, or may be straight, or have a combination of straight and vertical sections. Whatever the design shape the tolerance on the profile will be 2 inches with respect to the design axis of the tunnels. For portions of the tunnel surfaces that lie above the ceiling, the tolerance on straightness is 2 inch in 10 ft and the tolerance on form is 4 inches with respect to the design axis.

These tolerance values refer to the total width of the tolerance zone. For example "1 inch" does not mean ±1, but rather means that all values for the measurement lie within a band of values no wider than 1 inch.

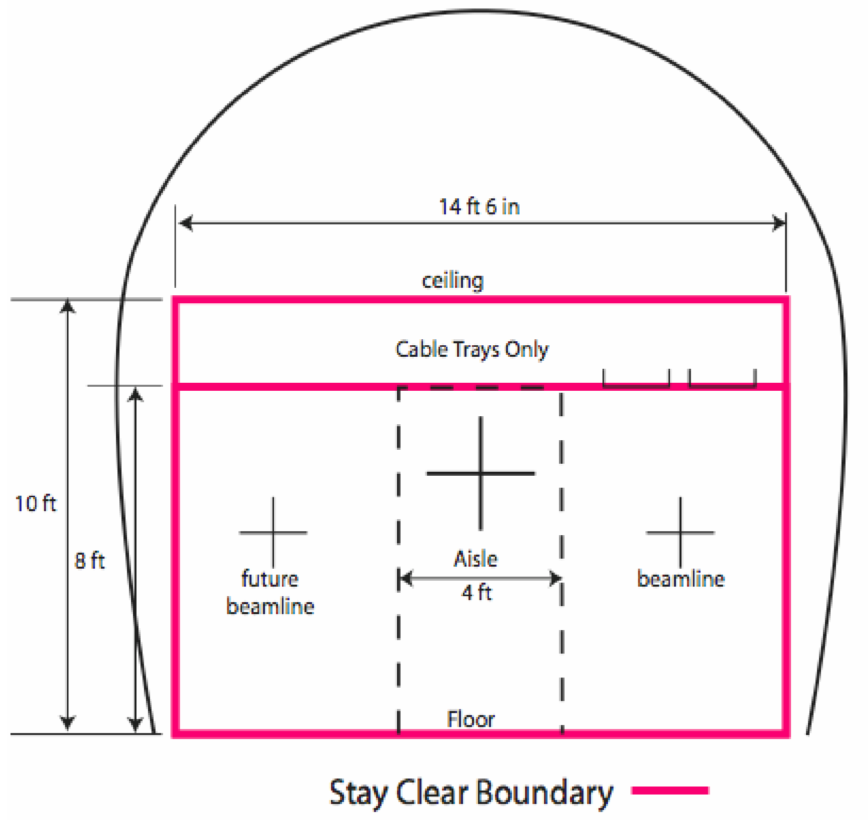
Floor Height The height of or in the Undulator Hall shall be 1.400 m below the Beam Centerline. The floor will not follow the Earth's curvature. Refer to figure below: The tolerance on the floor flatness shall be +-3/8 inch over any 10 ft span. All points on the floor shall be within +-1 inch of the basic height. (The floor level is to remain constant throughout the entire length of the LCLS facility at approximately - 247'-3". Construction joints and cracks should be filled and smoothed.



PLANNING CONSIDERATIONS & CRITICAL FACTORS, continued	Differential Settlement Differential settlement of points along the floor of the UH cause misalignment of the Undulator system components. After the first six months following the completion of construction, the differential settlement rate should be less than 0.5 µm/day RMS, measured at points 10 meters apart. This is considerably more than the observed long term average rate in the nearby linac housing which is 0.21 µm/day RMS @10 meters. For clarifications, to measure the differential settlement rate, height measurements are taken on the floor at regular intervals along the length of the tunnel. The height profile is recorded and a subsequent measurement is made at a later time. The change in the heights between the two measurements at the various points is calculated and the difference of the change in heights for adjacent points is taken. The RMS value is calculated from that difference of adjacent points. If the measurement interval is not 10 meters, the RMS value may be scaled to 10 m assuming the RMS is proportional to the square root of the distance between points.	
FINISHES	Wall and tunnel ceiling	Reinforced concrete, gunite, light color, steel trowel finish.
Care should be taken to specify finishes that minimize particulate and dust generation, as well as provide good reflectance and low glare.	Ceiling	Drop ceiling, no spec on finish.
	Floor	Sealed concrete and resistant to heavy load pressure. Steel trowel finish or equivalent. Refer to LCLS Esd 1.9-103 Specification
	Base	
	Doors	Single panel thermally insulated door for Thermal Barriers
	Fenestrations	None
	Acoustical/Thermal	Thermal Barrier at downstream end of BTH - 4" metal stud wall
APPLICABLE STANDARDS	29 CFR Part 1910 Occupational Safety Health Standard Dept of Labor and Part 1926 Safety and	
	Health Regulations for Construction Dept of Labor.	
	Uniform Building Code (UBC) 1997 including appendixes, National Electrical Code (NEC) 2002,	
	2003 Uniform Mechanical Code (UMC) including appendixes, 2003 Uniform Plumbing Code (UPC) including appendixes,	
	Uniform Fire Code (UFC) 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 Health Act (OSHA), General Services Administration 41 CFR part 101-19,	
	Environmental Protection Agency 40 CFR Parts 264 and 265	
	SLAC Environmental safety and Health Manual, General Industrial Activities Storm Water Permit (SLAC Permit), NFPA 101 Life Safety Code, Title 24 Energy Code Standards, DOE Standard 10 CFR Part 435, ASHRAE/IES Standard 90.1,	
	Fire Marshal requirements, LCLS Cabling Standard and SLAC LOTO	

VIEWS & SCHEMATICS (N. T. S.)

Figure No. 1



End view looking west showing possible configuration of tunnel and equipment.

MECHANICAL REQUIREMENTS	HVAC

Quantity	Value	Units
Air Temperature (nominal)	20.0	°C
Max. Air Temp Deviation	±0.2	°C
Max Wall Temp Deviation from nominal	1.0	°C
Max 24 hr ave air Temp deviation	±0.1	°C
Max warming or cooling rate	0.05	°C/hr
Max flow velocity	1	m/s
Max relative humidity	45	%
Min relative humidity	35	%
Pressure	> 0	
Max temp under fault conditions	30	°C
Fan on/off control manual over-ride	yes	

☒	Heating system	Temp:	☐	Mechanical humidification
☒	Air conditioning	Temp: 20C	☐	Direct exhaust system
☐	Direct supply		☒	Positive pressure system
☐	Indirect supply		☐	Negative pressure system
☐	Smoke control system		☐	Standard registers
☒	Temperature sensors and connection to SLAC site wide DDC system		☐	Requirement for gases

List of Gases -

a) Range of net heat load in tunnel is +- 8.5 kW from process equipment for the entire undulator tunnel.
b) Process equipment loads will be uniformly distributed along the tunnel length.

Communications

☒	Telephone	☐	PA speakers
☒	Dataport	☐	PA station
☒	**Cable Trays:** Two 2 foot width cable trays are required at the 8 ft level (bottom of tray at 8 ft), centered on the beamline. See comments		
☐	Payphone	☐	CCTV camera
☒	Fire alarm station	☐	CCTV monitor
☐	Intercom		

Comments:
a) Cable trays shall be made of galvanized steel, 24" x 6" for power cables. Provide grounding for each cable tray 1#4/0 bare copper

Plumbing/Fire Protection

☐	Hot water system	☐	Electric watercooler
☐	Cold water system	☐	Drinking fountain
☐	Tempered water	☒	Smoke detection system
☐	Waste drain	☒	Wet Sprinkler System
☐	Floor drain	☐	Eye wash
☒	Trench drain		

Comments:
a) Compressed air @ 85 PSI required (particle free, oil free & dry) See figure No.2 for locations.
b) Drainage system must provide a means to collect any water that may be leaked into the tunnel, either ground water or process water, for radioactivity measurement and disposal.
Refer to Figure No. 2

ELECTRICAL REQUIREMENTS	**Power supply**	☒	208 Volts outlets	☐	Uninterrupted power supply	
		☒	110V outlets	☒	Special electric- See figure # 3	Type:
			Emergency power			
		Comments: a) One quad AC (110V, 1 phase, 20A) receptacle every four meters-clean power, 10 amps running load. See figure No. 3 b) Three welding outlets 480V, 3 phase, 100 amps-See figure No. 3 for locations. c) One 208 Volts, 3 phase, 30 amps outlet every 12 meters- 10 amps running loads. Precise location to match undulator sections. Power evenly distributed between two panels mounted one at each end of the tunnel. See figure No. 3. d) Convenience outlets (110 volts, 1 phase, 20 amps) located as required by Code for power tool / temporary equipment. Refer to figure No. 3 for locations				
	Lighting	☒	Light fixtures	☐	Remote lighting control	
		☐	Fixture type I: Downlight	☒	Light switches	
		☐	Fixture type II: Bollard (exterior)		Lighting level	see comments
		☒	Emergency lighting- Refer to ESD 1.9-104 Specification			
		Comments: Lighting in the Undulator Hall should be designed to have the following characteristics: • It should be possible to operate at two levels of lighting: 30 fc for access, and 5 fc for operation (when no one is allowed to be in the hall). Considerations that should be weighed by the design engineer in choosing the lighting type should include: • Reducing the Watts per square meter incident on the 'process equipment' and floors and walls. • Minimize the maintenance frequency, ease of bulb/fixture replacement. The above items constitute the lighting requirements. I add that because of the tight temperature tolerance and high cost of maintaining such small temperature range in the Undulator Hall, special lighting technologies such as diode lighting or fiber optic lighting have been discussed. Such ideas may have a higher initial cost than conventional solutions, but pay off in the long run by reducing overall UH operating and maintenance costs. They may also contribute to improved safety if bulb/fixture replacement frequency can be reduced. There is not any requirement as to the 'color' of the light. For example, heavily blue-white light from LEDs would be acceptable. This text only refers to normal lighting requirements — not emergency lighting.				
RADIATION/SEISMIC/VIBRATIONS ISSUES	**Comments:** Radiation will be present duration operation only. However, radiation levels are low and special selection for radiation resistant materials is not needed.					
SPECIAL REQUIREMENTS FOR EQUIPMENT	**Comments:** a) Must comply with SLAC Seismic Safety Standards. b) Rebar used in Undulator Hall shall be demagnetized. c) Areas above the ceiling must be searchable for PPS operations					
ENVIRONMENTAL NEEDS	1.0					
	2.0					
	3.0					
	4.0					

FIGURE No. 2

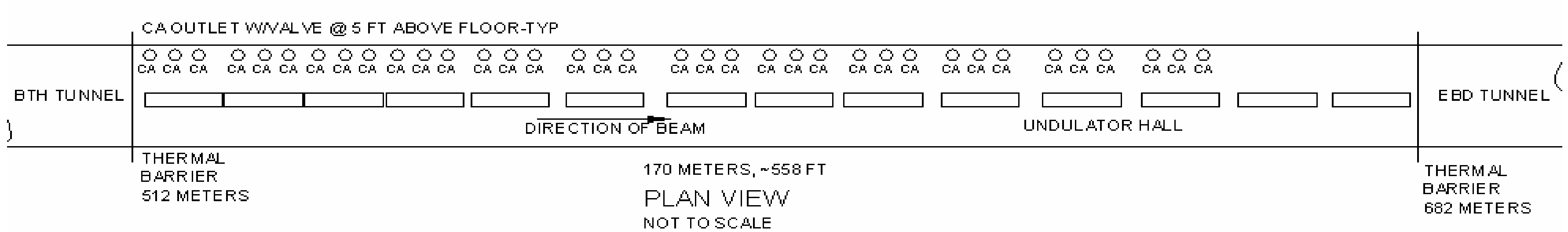
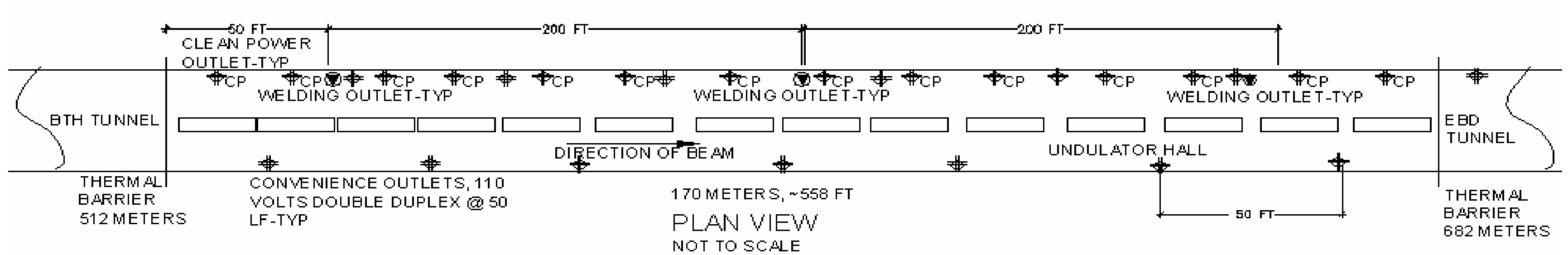


FIGURE No. 3


50 FT
200 FT
200 FT
CLEAN POWER
OUTLET-TYP
WELDING OUTLET-TYP
WELDING OUTLET-TYP
WELDING OUTLET-TYP
BTH TUNNEL
EBD
TUNNEL
DIRECTION OF BEAM
UNDULATOR HALL
THERMAL
BARRIER
512 METERS
CONVENIENCE OUTLETS, 110
VOLTS DOUBLE DUPLEX @ 50
LF-TYP
170 METERS, ~558 FT
PLAN VIEW
NOT TO SCALE
50 FT
THERMAL
BARRIER
682 METERS