LCLS Laser Scan
Alignment Engineering Group

Project Summary

Complete a laser scan of the LCLS beamline from the photo-injector (Sector 20 in the linac) through to the Far Experimental Hall (FEH). The planned scans and associated control surveys are not in order:

- Linac from Sector 28-1 backwards.
- Remainder of linac (28-2 to 30) plus BSY.
- LCLS injector vault.
- New LCLS tunnels (order to be determined).

Access Schedules				
Region	**Downtime Week**	**Dates**	**Business Days**	**Area Manager**
Linac	1, 2, 3	Aug. 21 to Sept. 5	11	Tom Graul
BSY	4, 5	Sept. 8 to Sept.19	10	Al Baker
Injector	6, 7	Sept. 22 to Oct. 3	10	Patrick Smith

Safety:

The IMAGER 5006 laser scanner is a Class 3R laser product. The radiant power is less than 4.75 mW with a maximum pulse duration of 260 µs. Class 3R lasers require no special permits at SLAC. This laser scanner has a “hazard distance” of 20 meters meaning that personnel within this distance should be monitored and directed to not look directly into the beam. Warning signs have been created and placed at entrances and at the extents to this region and the responsible personnel are always present during an active scan.

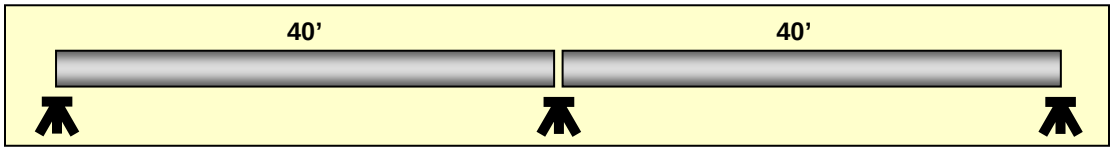
Linac Laser Scan

Access Schedule: August 21st to September 5

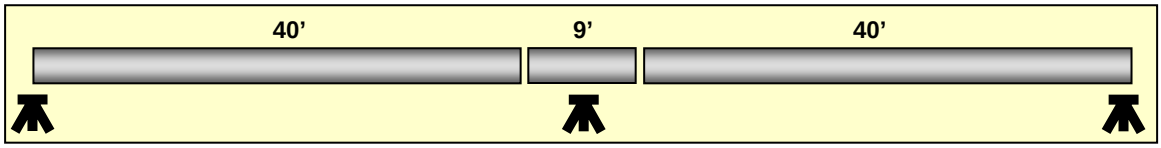
Scheme:

Scan the LCLS beam-path and infrastructure in the accelerator housing from 28-1 backwards to Sector 20. Next scan the rest of the accelerator housing from 28-1 to Sector 30. Include light pipe surveys at regular intervals. Prior testing and discussion lead to the following plan:

- First scan position near 27-8.
- Determined that useful scans limited to about 15 meters from instrument, therefore one scan will cover two 40' (12.2 m) linac sections.
- 5 Cyra targets per section (nominally)
- High resolution scans chosen. Scan range covers from 1m to 20 m. (Note that in Z+F manual, pg. 46-47, "Typical scan resolution High; very suitable for further tasks. Super High and Ultra High are only recommended for sections or special tasks."
- Each subsequent scanner set-up would be located near each jack-point.



- For the 9' drift sections (separating each sector), the scanner will be set-up approximately in the middle of that short section.



- Scan man-hole alcoves (at housing level) by slightly shifting instrument location.
- Survey 3 jack-points, skip 3 sections (i.e., skip 2 jack-points).
  - For example: Measure 28-1, 27-8, 27-7; *skip 27-6, 27-5*; measure 27-4, 27-3, 27-2.

Scanning and Surveying Equipment		
Measuring Equipment	**Scanning**	- Zoller+Fröhlich IMAGER 5006 laser scanner (distance accuracies from 0.5 to 3 mm for the chosen range) - Z+F li-Ion battery pack and charging cradle - Ethernet, charging and power supply cables - Power supply (KNL-24) - Transportable rechargeable battery pack (TRAPP-15-24) - Tripod (black stand) and tribrach - 10 Cyra targets - 2 target stands (red) - Laptop computer - Class 3R laser warning signs - Field note binder
	Surveying	- Leica TCRA1105 reflectorless total station (distance accuracies 2 mm + 2 ppm) - 3 light pipe jack-point fixture arms - 2 boxes containing total of 8 cylindrical mounts - 1 box (blue) 1.5” targets & 1 SMR
IMAGER 5006 Specifications **(see Z+F manual, pages 46-47)**	**Resolution**	High (10000 pixels / 360º)
	Scan Time	High low-noise: 6 min 44 sec High: 3 min 22 sec
	File Size	Approx. 180 MByte (compressed)
	Other Settings	

Location Description (LINAC)		
Linac Accelerator Housing	**Housing**	- Accelerator housing is a 10' tall by 11' wide - One Sector is nominally 333 ft - Housing floor about 35' below floor of Klystron Gallery
	Sector	- Support girder (aluminum light pipe) is 24" in diameter - One Sector = (8 x 40') + (1 x 9') modules - Each module (section) supported at input end by a pair of precision screw jacks from the floor and one jack from the wall

Learned Information and Comments (Aug. 2008)		
Personnel	**Planning**	- Catherine LeCocq - Mike Gaydosh - Brian Fuss
	Surveying & Scanning	- Mike Gaydosh - Brian Fuss - Francis Gaudreault
Scanning & Surveying Measurement Times	**Surveying**	- Approximately 40 to 60 minutes per set-up
	Scanning	- Approximately 15 to 20 minutes per set-up
Comments		- Testing revealed that Super High and Ultra High scans are troublesome; scanner locks up and managing very large data files very difficult. - Tested difference between low power and high power scanning modes for improving data from reflective surfaces; found no obvious difference. - Problem with scanner operating without laptop. - TCRA1105 attempts to track SMR; setting change should fix this.