Sector 20 – LCLS Injector Installation
August 29, 2005 AEG Summary

Linac Design

Sector 20 is 20*333.33 feet from the origin of the linac, i.e. Station 66+67. The nominal slope for this Station per the Aetron-Blume-Atkinson table is .492% or 0.00492 radians.

2004 Summer Downtime

The shielding walls were laid out showing the following as-built data for the holes:

Pipe	X (in)	Y (in)	
Beam Line Pipe 1	0.141	-0.266	South Near Linac
Beam Line Pipe 2	0.007	0.081	
Beam Line Pipe 3	0.218	-0.005	
Beam Line Pipe 4	-0.379	-0.011	North Near LCLS Injector Room
Laser Pipe (East) 1	-0.144	0.136	South Near Linac
Laser Pipe (East) 2	0.082	0.264	
Laser Pipe (East) 3	0.139	0.286	
Laser Pipe (East) 4	-0.787	0.312	North Near LCLS Injector Room
Laser Pipe (West) 1	0.109	-0.072	South Near Linac
Laser Pipe (West) 2	0.088	-0.099	
Laser Pipe (West) 3	0.138	0.223	
Laser Pipe (West) 4	-0.288	-0.009	North Near LCLS Injector Room

These are as-built in the injector system (with a pitch chosen as 0.00403 radians at the time). More details can be found at:
http://www-group.slac.stanford.edu/met/Align/Down2004/Week_Summary/Down2004_All_Weeks.pdf

Because the distance between the shielding walls is about 2.6m and the holes are now 6“ diameter (they will be later reduced to 3”), the laser pipe can be either horizontal or in the plane of the linac-injector.
Decision: in the plane of the linac

AEG Quad Spacing Analysis

A day-to day description of the activities of the February 2005 ROD can be found at:
http://www-group.slac.stanford.edu/met/Align/LCLS/LCLS-Sector2021.pdf
It concludes with:

- the measured pitch of the linac in Sector 20 = 0.00491 radians
- the spacing of the quads from Q20-701 to Q21-901

Laser Penetration

An email from July 7, 2005 stated the following:

Here are the coordinates for the top and bottom of the Sector 20 penetration:

	Z (m)	X (m)	Y (m)
PENTOP	-14.29034	11.02165	8.98742
PENBOT	-14.26470	11.01528	1.35477

The pipe is roughly 300 inches long and is 19.25 inches in diameter. The coordinates are in a pitched system with the origin being the intersection of the LCLS injector beam with the accelerator (134.964 inches downstream of linac quad LI20 901) with +Z being along the accelerator. The design pitch of the accelerator at sector 20 is -0.00492 radians. From our measurements earlier this year we found -0.00491 radians.

These observations were made with a laser tracker and indicated that the hole is neither perpendicular to the accelerator nor vertical. It makes an angle of 0.0034+/-0.0007 radians from the normal to the accelerator. This is also 0.0015 radians from vertical.

These numbers allow an installation either vertical or normal to the linac.
Decision: in the middle of the hole where it fits naturally

Laser Scanner Point Cloud

The laser scans taken during the February ROD were combined and registered in the linac system. They produced a point cloud of the whole injector area that was sent in an email dated August 22, 2005, both as a text file and as a dxf file.
A couple of the old total station shots to the shielding wall made during the 2004 Summer downtime were checked against this point cloud (see email of 8/24/05)

These values allow planning to the level of a couple of centimeters.

Adopted Angles for 2005 October Downtime

From the previous observations, the following values will be used by AEG for the installation in the injector area:

- Linac:
  - Pitch 0.00491 radians
  - Roll 0
- Injector
  - Pitch 0.00402 radians
  - Roll 0.00282 radians

As a reminder, the angle between the linac and the injector line is 35 degrees and the intersection point is 134.964 inches downstream of the center of quadrupole LI20-901.