Sectors 20-21 Quadrupole Spacing for LCLS Deck
AEG Activities Summary

Thursday February 10, 2005 **Time charged: 0h**

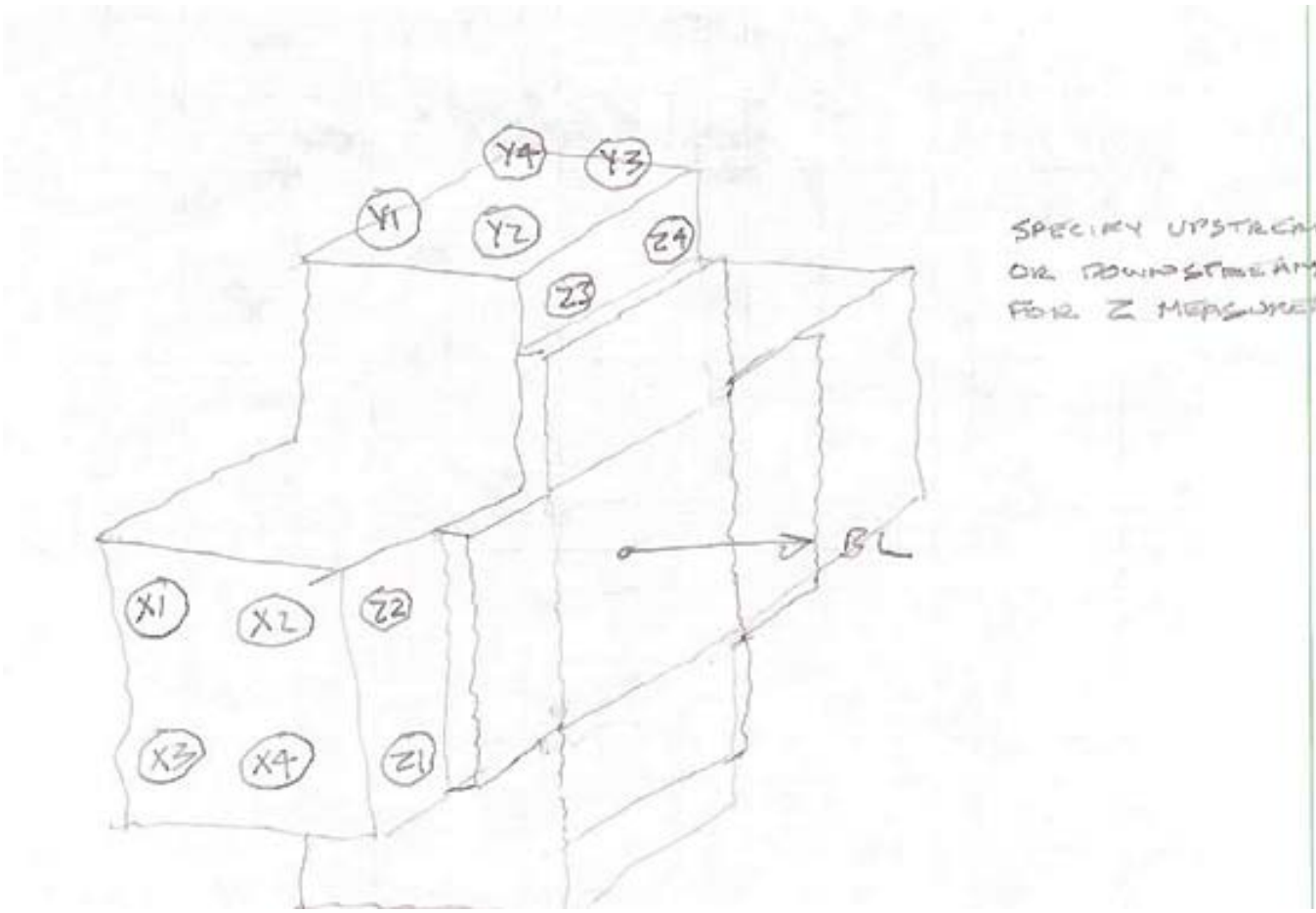
- Fill out the new "Work Authorization Process" form
- Start the LOTO process
- Organize a group meeting: Safety was the main focus and it concluded with a request for a longer rope to be used with the bucket as well as the idea of using SEM to lower down all the heavy equipment. The technical aspects of the job were then reviewed. Here are the chronological steps:
    - Install new monumentation
    - Create network using TC2002 covering:
        - Some old monuments around the injector tunnel shielding wall (beware of the one floor monument with no value: F2111)
        - All the new monuments
        - All the jackpoints between 21-1 and 21-9 (look at roll for the fixture)
        - 2 brass plates (Sector 21 and 22). Decided to lay the fixture flat on the plate (not leveled as usual). Perform a reality check distance with a tape.
        - The origin of the mechanical drawing (refer to hard copy and call Carl Rago to have him point to exact feature)
    - Level 9 floor points: the 7 new ones, one old and F2111.
    - Perform one TC2002 set-up using similar resection pattern for each quad from 21-201 to 21-901 (need to prepare drawing showing location where to put reflector as well naming scheme). Do only "one shot-one face" on the quad as there are no fiducials to repeat on.
    - If time permits, scanning of the area from quad 20-701 to 21-301 making sure that the holes in the shielding wall as well as all the local penetrations can be well determined. The plan is to use Cyclone software with large targets to do the registration but also place painted balls on some of our monuments to perform and then check the coordinate transformation.

Friday February 11, 2005 **Time charged: 20.5h**

- Read the linac AHA.
- Fill out a SEM request to get part of the gear lowered down at Sector 19. Gather equipment in a gang box; bring scanner boxes and level rods to be ready for crane work:

- At the end of the day, all the 24 wall and 7 floor monuments were installed. The wall monuments are now ready to be used and were left with plastic covers on. The floor monument grout needs to set and they were left with the cross fixture in place. The next step was to remove these fixtures and vacuum each monument. The HEPA vacuum provided by OHP was parked in the aisle for use on Monday.

- The location for future automatic level and TC2002 observation files is: N:\LINAC\SECT20*\SRV2.
- Here is a rough sketch for the quadrupole shot identification (final drawing pending).



This is a repeat procedure same as the one used during the surveys of last summer. Note that it is necessary to indicate either upstream or downstream shots for the final Z location.

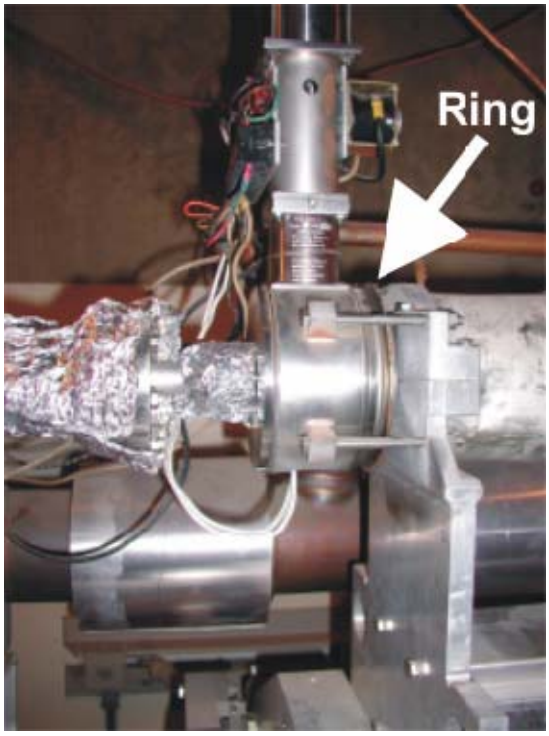
Monday February 14, 2005 **Time charged: 24h**

- Cleaned the floor monuments.
- Started to measure the network with the TC2002.
- By laying the target plate over the brass plate it turned out that the target plate is not flat on the brass plate due to the unevenness of the brass surface. A tolerance of 1-2 mm is possible.

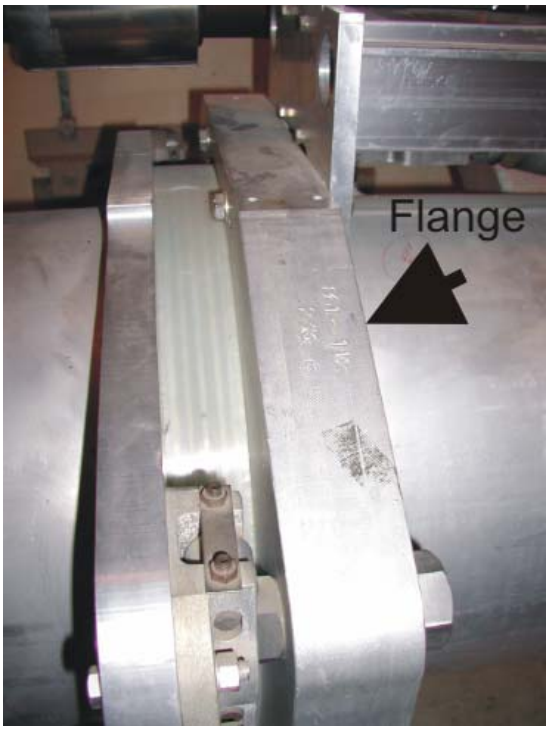
- Meet with Carl Rago in Sector 20 to clarify which points should be measured, see pictures below. It was agreed that the z-coordinate of the flanges 20-9, 21-1 and 21-2 are to be determined.

Additional points of interest referred to by Carl Rago.
Number 1 is a brass ring, numbers 2 and 3 are flanges on the vacuum pipe.

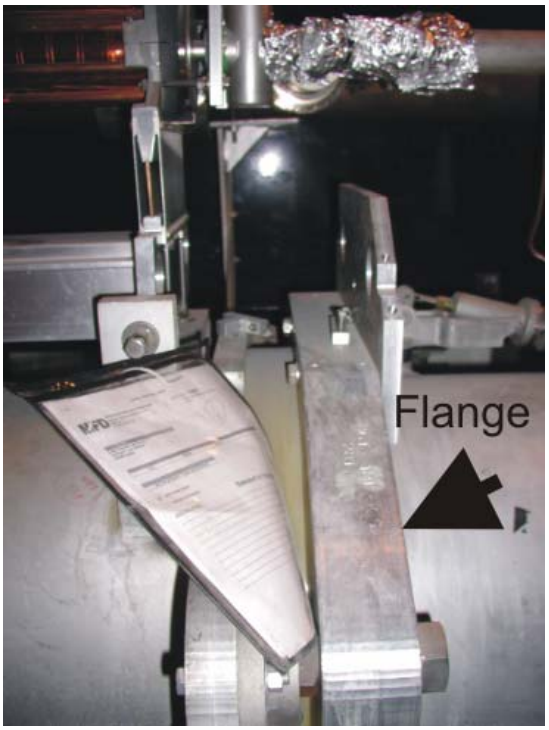
The ring itself is not accessible so it was decided to measure the valve surface and use a caliper to determine the offset to the ring.



Detail of the brass ring with the valve beside



Flange #3



Flange #2

Thursday February 15, 2005 **Time charged: 16 h**

- Finished the network measurements with the TC2002.
- Leveled the floor monuments.

Wednesday February 16, 2005 **Time charged: 24h**

- Determination of the positions of the magnets and the points of interest for Carl Rago.
- Started laser scanning of the region. Due to the confined space, the Leica Cyclone Software could not be used because of the security distance of 0.8 m. Therefore the Z&F Software had to be used.

Thursday February 17, 2005 **Time charged:** 21h

- Laser scanning of Sector 21.
- By request of Carl Rago and Lynn Bentson, floor and wall monuments were installed in Sector 20 on the floor and along the south wall following the scheme of Sector 21. Due to the lack of LOTO it was not possible to set the wall monuments on the north side. For the same reason we can not actually measure the points. To obtain the necessary permit will take approximately 10 days according to Thomas Graul.

Friday February 18, 2005 **Time charged:** 13h

- Finished laser scanning of Sector 21.

Tuesday February 22, 2005 **Time charged:** 16h

- Processed the monument network.
- Started laser scanner analysis

Conclusion

At the end of this job, a new set of coordinates for all the monumentation in Sector 20-21 and the alcove have been established. For AEG purposes, the coordinates are in the usual "mixed form". The coordinate system is leveled at the origin which has been chosen as the intersection point of the LCLS injector line and the accelerator line. This origin is by definition through the MAD deck and is located 134.964 inches downstream from the center of quad L20901.

For design purposes, all the requested features to be surveyed (and laser scanner registration) had been carried out in the linac system. To realize the linac system through the overall set of observations, a line through the 13 jackpoints had also been fitted. The following are the coordinates of the jackpoints along this line:

	Z (in)	X (in)	Y (in)
JP206	-1467.963	0.021	-0.019
JP207	-981.981	0.025	-0.029
JP208	-495.779	0.022	0.000
JP209	-129.750	0.012	0.007
JP211	221.742	-0.013	0.005
JP212	587.933	-0.008	0.022
JP213	1074.140	-0.012	0.002
JP214	1560.097	-0.017	0.000
JP215	2046.131	0.000	-0.008
JP216	2532.072	-0.002	0.001
JP217	3018.194	-0.007	0.022
JP218	3504.331	0.012	-0.019
JP221	4102.260	0.034	-0.023

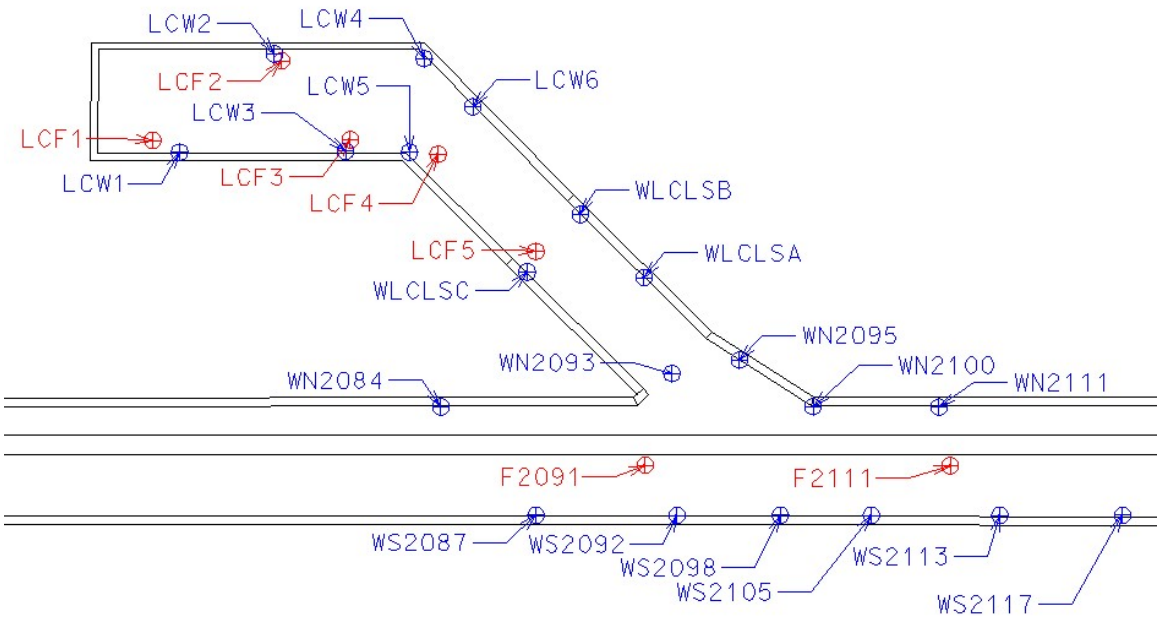
Subsequently this line was ideally translated to the accelerator axis (translation in X and Y: 16.635 and 10.000 inches respectively). A look at the quad center coordinates indicated a need for a slight final change and thus an additional 20 mil translation in Y was decided upon.

	z (m)	x (m)	y (m)	Ideal z (m)	Act - Ideal
Q20701	-25.0248	0.0004	-0.0009	1930.399	-0.0039
Q20801	-12.6750	0.0004	-0.0004	1930.400	0.0019
Q20901	0.0000	0.0002	0.0003	1930.400	0.0000
Q21201	14.8512	-0.0002	0.0004	2032.000	0.0011
Q21301	27.1995	-0.0002	0.0005	2032.001	0.0054
Q21401	39.5454	-0.0002	0.0002	2032.000	0.0063
Q21501	51.8877	-0.0001	0.0002	2032.000	0.0046
Q21601	64.2338	0.0002	0.0001	2032.000	0.0057
Q21701	76.5795	0.0004	-0.0001	2032.000	0.0064
Q21801	88.9287	0.0007	-0.0005	2032.000	0.0126
Q21901	101.5978	0.0008	-0.0007	2031.999	0.0107
Brass20	-99.0025			0.000	0.0044
Brass21	2.6000			0.000	0.0069
Brass22	104.2017			0.000	0.0086
JPF209	-3.3398				
JPF211	5.5881				
JPF212	14.8888				
VAL211	5.6285				

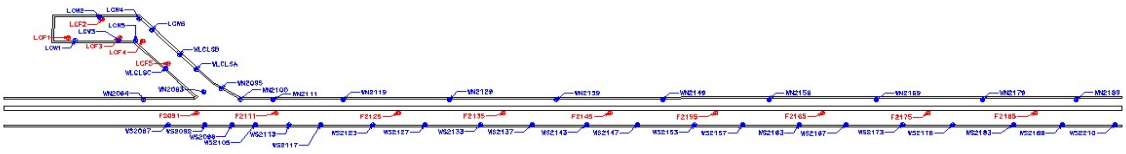
To transform between this linac system with origin at the center of quad L20901 and the AEG system, a simple orientation about the second axis of + 0.2812 degrees is needed. This number (0.00491 radians) is the angle obtained by fitting a line through the jackpoints. It is very close to the designed slope of the accelerator at 20-9 (-0.00492 radians). It should also be noted that the last coordinate in the linac system (y value) is a geometrical quantity while the last coordinate in the AEG system (Y value) is a height.

Appendix

Here is the list of the new monumentation created for the LCLS injector installation. The coordinates are in the AEG system described above:



Point	Z (m)	X (m)	Y (m)
LCF1	-20.81849	9.19658	-1.53733
LCF2	-16.91751	11.60248	-1.57610
LCF3	-14.83927	9.22142	-1.58462
LCF4	-12.18187	8.78355	-1.59863
LCF5	-9.22770	5.84303	-1.61616
LCW1	-19.99915	8.84559	0.59593
LCW2	-17.14026	11.81217	0.60343
LCW3	-14.97717	8.87054	0.60656
LCW4	-12.60415	11.67066	0.67422
LCW5	-13.04971	8.84402	0.69125
LCW6	-11.13518	10.21272	0.68308
WLCLSA	-5.95500	5.05603	0.25007
WLCLSB	-7.88305	6.96680	0.21743
WLCLSC	-9.48945	5.22523	0.21780
WN2084	-12.10025	1.15130	0.55865
WN2093	-5.11568	2.15914	0.68368
WN2095	-3.07364	2.56272	0.23574



Point	Z (m)	X (m)	Y (m)
F2091	-5.91735	-0.60871	-1.63832
F2111	3.30029	-0.62281	-1.66911
F2125	17.49952	-0.61198	-1.76235
F2135	29.70600	-0.60688	-1.82788
F2145	42.09582	-0.61096	-1.88478
F2155	54.37678	-0.60884	-1.94937
F2165	66.80266	-0.62092	-2.00902
F2175	79.06743	-0.59934	-2.07728
F2185	91.52878	-0.59633	-2.13504
WN2100	-0.84411	1.16038	0.60961
WN2111	2.96556	1.14572	0.43741
WN2119	11.12463	1.14527	0.37182
WN2129	23.45605	1.14490	0.36447
WN2139	35.85378	1.13964	0.31899
WN2149	48.23538	1.14645	0.22918
WN2159	60.60108	1.13767	0.24126
WN2169	73.01892	1.14336	0.11995
WN2179	85.38721	1.14255	0.02748
WN2189	96.28398	1.14741	-0.03027
WS2087	-9.22056	-2.12179	0.53957
WS2092	-4.95953	-2.12666	0.47353
WS2098	-1.83360	-2.12124	-0.46280
WS2105	0.91974	-2.12584	0.39604
WS2113	4.80636	-2.12569	0.39405
WS2117	8.51198	-2.12104	0.04693
WS2123	14.56008	-2.12331	0.29180
WS2127	20.59661	-2.12286	0.24509
WS2130	4.80625	-2.12563	0.39479
WS2133	27.10238	-2.12166	-0.24723
WS2137	33.06625	-2.12436	-0.07541
WS2143	39.40018	-2.12763	0.15353
WS2147	45.29571	-2.12872	0.16072
WS2153	51.90718	-2.12522	-0.11814
WS2157	57.50667	-2.12933	0.08074
WS2163	64.10293	-2.13005	-0.16562
WS2167	69.51841	-2.12814	-0.33500
WS2173	76.13295	-2.12605	0.01591
WS2178	81.94222	-2.12656	-0.63650
WS2183	88.98964	-2.12703	-0.08903
WS2188	94.67446	-2.12758	-0.08286
WS2210	100.77051	-2.12669	-0.16827