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THE OCTOBER 1989 SURVEY OF THE LINAC TO BOOSTER TRANSPORT BEAM LINE

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U.S. Department of Energy

USDOE Office of Science (SC)

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Introduction

The Linac to Booster transport beam line was surveyed on October 9, 1989. Coordinates were measured with respect to the AGS geodetic grid, for the location of the apex of each proton injection line magnet. It was found that coordinates reported prior to this survey needed some correction.

In particular, it was found that the apex of the kicker magnet P1K1 installed in the HEBT line was displaced approximately four inches downstream from the position used in calculating beamline component positions in Table 4-1 of the Booster Design Manual, Revision 1, 1988. Based on the October 9, 1989 Survey measurements, the positions of the beam components along the line were re-calculated, and the line was installed. The installation took into account the actual location of kicker magnet P1K1, and was subject to the constraints that the line endpoint, at P1QD5, remained fixed and that the bending angles in the four dipoles were held equal to one another.

This note is intended as an update to Table 4-1 of the Booster Design Manual, Revision 1, October 1988. for the AGS Booster Project. Corrected magnet apex coordinates are given for the injection line magnets. Corrected bend angles are also given.

Description Of The Injection Line

The Booster Injection Line components are described in section 4.1 of the Booster Design Manual [1]. The locations of the proton injection line elements are listed in Table 4-1 as a tabulation of coordinates of the apexes of the injection line magnets. Apex coordinates are given in Booster, AGS, and BNL coordinate reference systems in Table 4-1, page 4-3.

A plan view diagram showing the injection line magnets is given in Figure 4-3, page 4-4 of the Booster Design Manual.

Coordinate transformations between the three coordinate reference systems are given by the following relations [2]:

I. AGS Grid to Booster Grid

X [Booster, Inches] = E [AGS, Inches] - EO [AGS, Inches]

Y [Booster, Inches] = N [AGS, Inches] - NO [AGS, Inches] where

EO [AGS, Inches] = 1,..48.88 , NO [AGS, Inches] = 15,459.36 ,

and

X [Booster, Meters] = (0.02540) x X [Booster, Inches] .

Y [Booster, Meters] = (0.02450) x Y [Booster, Inches] .

X [Booster, Feet] = (1 / 12) x X [Booster, Inches] .

Y [Booster, Feet] = (1 / 12) x Y [Booster, Inches] .

II. Booster Grid to BNL Grid

E [BNL, Feet] = EO [BNL, Feet] + X [Booster, Feet]

N [BNL, Feet] = NO [BNL, Feet] + Y [Booster, Feet]

EO [BNL, Feet] = 98,517.19 NO [BNL, Feet] = 102,438.28 .

We note that the origins of these grids are not the same.

The October 1989 Survey

The survey data for the October 1989 survey of the Linac to Booster Transport Line are stored in File B:LTB91989.100 of the BNL Survey Group.

The surveyors were Francis X. Karl, Donald L. Kazmark Jr., Joseph C. Roecklein and John S. Sullivan.

The proton injection line magnets are designated by the following symbols:

PID	Proton Injection Dipole
PIQF	Proton Injection Quadrupole, Focusing
PIQD	Proton Injection Quadrupole, Defocusing
PIK	Proton Injection Kicker

The survey results are given in the following tables.

Table 1.

Location Of The Proton Injection Line Elements.

Survey Point Number	Injection Element Number	Magnet Element Name	Location Of Magnet Apex [AGS, Inches] E	N
41	1	PIK1	-658.9432	14516.9353
42	2	PIQF1	-502.3375	14417.9048
43	3	PIQD1	-459.0797	14390.5502
44	4	PIQF2	-415.8219	14363.1959
45	5	PIQD2	-372.5642	14335.8415
46	6	PIQF3	-329.3064	14308.4872
47	7	PID1	-282.1897	14286.0455
48	8	PID2	-197.8758	14265.1588
49	9	PIQF4	-160.0765	14287.6274
50	10	PID3	-122.2772	14310.0960
51	11	PIQF5	-101.7998	14349.0100
52	12	PID4	-18.5660	14507.1830
53	13	PIQF6	-26.6211	14629.6364
54	14	PIQD3	-29.9805	14680.7070
55	15	PIQF7	-35.9242	14771.0627
56	16	PIQD4	-39.2836	14822.1334
57	17	PIQF8	-45.2272	14912.4881
98	18	PIQD5	-50.6540	14994.9880

Table 8.

Spacings Between Injection Line Elements

From Element Number	To Element Number	Distance [Inches] Apex to Apex
End Of Linac Tank 9	1	723.125
1	2	185.290
2	3	51.181
3	4	51.181
4	5	51.181
5	6	51.181
6	7	79.410
7	8	64.320
8	9	43.973
9	10	43.973
10	11	43.973
11	12	178.736
12	13	122.718
13	14	51.181
14	15	90.551
15	16	51.181
16	17	90.550
17	18	82.678

Table 3.

Bend Angles Of Successive Sections Of The

Linac To Booster Transport Beam Line

Linear Section Between Apexes	Deflection Deg/Min/Sec	From Linear Section
1 To 7	7 / 41 / 33.5	Linac Beam Exit
7 To 8	31 / 31 / 3.7	1 To 7
8 To 10	31 / 31 / 4.0	7 To 8
10 To 12	31 / 31 / 4.0	8 To 10
12 To 18	31 / 31 / 4.0	10 To 12

TABLE 4 Location of the proton injection line elements.

Location of Proton Injection Line Elements

No.	Name	Booster Coord.		AGS Coord.	
		x(m)	y(m)	E(m)	N(m)
1	PIK1	-45.9187	-23.9376	-658.9432	14516.9353
2	PIQF1	-41.9409	-26.4530	-502.3375	14417.9046
3	PIQD1	-40.8422	-27.1478	-459.0797	14390.5502
4	PIQF2	-39.7434	-27.8426	-415.8219	14363.1959
5	PIQDF2	-38.6447	-28.5374	-372.5642	14335.8415
6	PIQF3	-37.5441	-29.2322	-329.3064	14308.4872
7	PID1	-35.8412	-30.3102	-262.1897	14266.0455
8	PID2	-34.2076	-30.3327	-197.8758	14265.1588
9	PIQF4	-33.2475	-29.7620	-160.0765	14287.6274
10	PID3	-32.2874	-29.1922	-122.2772	14310.0960
11	PIQF5	-31.7673	-28.2029	-101.7998	14349.0100
12	PID4	-29.6531	-24.1853	-18.5660	14507.1830
13	PIQF6	-29.8577	-21.0750	-26.6211	14629.6364
14	PIQD3	-29.9431	-19.7778	-29.9805	14680.7070
15	PIQF7	-30.0940	-17.4828	-35.9242	14771.0627
16	PIQD4	-30.1794	-16.1856	-39.2836	14822.1334
17	PIQF8	-30.3303	-13.8905	-45.2272	14912.4881
18	PIQD5	-30.4682	-11.7950	-50.6540	14994.9880

References

1. Booster Design Manual, AGS Booster Project, Accelerator Development Department, Brookhaven National Laboratory, Upton NY, Revision 1 , October 1988.

2. Z. Parsa, AGS Booster Geometry and Coordinates, Booster Technical Note No. 100, Accelerator Development Department, Brookhaven National Laboratory, November 1987.