SURVEY OF EPA AND OF THE INJECTION AND TRANSFER LINES WITH MAD

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INTRODUCTION

As part of the effort to create a modelling system for the EPA, it was decided to use the program MAD (Methodical Accelerator Design) as the principal simulation program. On the other hand, the CERN surveyors now work with MAD output ("TAPE3" files). This is why it was attempted to use the "SURVEY" option in MAD to create a listing of the whole machine.

NOMENCLATURE USED

An identifier is limited to 8 characters in MAD. In accordance with the official PS nomenclature, the names have the following format:

- 2 characters for the line (ring, injection or ejection),

- 3 characters for the element type,

- 2 or 3 (for drifts only) characters for the exact position (section, subsection, ..),

- some elements (quadrupoles in particular) have been represented by two halves, so as to have a computation at the center of the element. The last character of the first half's name will be "U" (UPSTREAM) and the second s "D" (DOWNSTREAM).

Examples :
- quadrupole in the ring HRQFWO2U (first half),
- drift in the positrons injection line IPDRI522,
- bending magnet in the electrons transfer line TEBHZ30,

As a consequence, the used nomenclature is in complete agreement with that of the LPI (PS/LPI Note 83-3) except for :
- the last character U/D added at the end of each splitted element;
- the first character H of the lines (HIP,HIE,HTP,HTE) omitted in order to keep a simple relation between the character's position in the name and its meaning. This greatly facilitates the element determination by the surveyors.

ELEMENTS POSITIONS

The position of each element has been carefully deduced from the mechanical drawings as the real representation of the machine to be built.
The origin in CERN coordinates of each line (point B for transfer and C for injection) was taken from the official EPA and transfer lines layout (PS/ML Memo 85-34). The direction of rotation is that of the numbering of the sections.

SURVEY WITH MAD

The ring and the transfer lines (EPA->PS) presented no particular problems (see Table 1 for the ring, 2 and 3 for the lines). Their survey is in complete agreement with the geometry already determined with AGS for the ring and with NEWBEATCH for the transfer lines.

However, the tilted injection lines were difficult. The tilts of the elements are computed differently in BEATCH (equivalently TRANSPORT) and in MAD : the local reference system rotates in MAD before and after the tilted element. For this reason, two bending magnets with the same deflection and the same angle with respect to the horizontal, do not have the same tilt in MAD (whereas the physical tilts of the elements are the same). The numerical values of the

tilts are :

- with MAD - IPBHZ10   -0.001716 rad

              IPBHZ20   3 x -0.001716 rad

              IPBHZ30   3 x   0.001716 rad

These values were chosen to keep the angle phi (elevation angle, between the reference orbit and its projection on the horizontal plane) constant.

- with NEWBEATCH, for the three bending magnets, 0.001716 rad.

It is possible to verify that the coordinates at these points are the same with both programs.

Also, some elements (the septa IPSMH..) are not tilted in reality but have to be tilted in MAD by an angle of -0.003433 rad, in order to keep the beam horizontal... The differences between the coordinates of the end point of the line with MAD and NEWBEATCH are of the order of a millimiter. However, the angle psi (roll angle of the local reference system) is not zero at this point, as it should be in the ring.

It was therefore decided to use NEWBEATCH, the corrected version of BEATCH, for the injection lines. Copies of both listings are shown in Tables 4 and 5. A memorandum describing the problem has been sent to E. Keil and F. C. Iselin.

POS. NO.	ELEMENT NAME	ELEMENT OCC. NO.	SEQUENCE SUM(L) [M]	ARC [M]	POSITIONS X [M]	Y [M]	Z [M]	ANGLES THETA [RAD]	PHI [RAD]	PSI [RAD]
BEGIN	RING		0.0	0.0	2102.322030	2433.660000	2114.571380	1.205766	0.0	0.0
1	HRSMHOOD	1	0.207500	0.207500	2102.515858	2433.660000	2114.645453	1.205766	0.0	0.0
2	HRDRI011	1	2.339500	2.339500	2104.507387	2433.660000	2115.406529	1.205766	0.0	0.0
3	HRCLE01	1	2.339500	2.339500	2104.507387	2433.660000	2115.406529	1.205766	0.0	0.0
4	HRDRI012	1	2.928500	2.928500	2105.057580	2433.660000	2115.616789	1.205766	0.0	0.0
5	HRQFWO2U	1	3.118500	3.118500	2105.235061	2433.660000	2115.684615	1.205766	0.0	0.0
6	HRQFWO2D	1	3.308500	3.308500	2105.412543	2433.660000	2115.752440	1.205766	0.0	0.0
7	HRDRI021	1	3.554340	3.554340	2105.642185	2433.660000	2115.840200	1.205766	0.0	0.0
8	HRCLE02	1	3.554340	3.554340	2105.642185	2433.660000	2115.840200	1.205766	0.0	0.0
9	HRDRI022	1	3.755950	3.755950	2105.830511	2433.660000	2115.912170	1.205766	0.0	0.0
10	HRBHZO2	1	4.345050	4.345050	2106.325999	2433.660000	2116.223769	0.813067	0.0	0.0
11	HRDRI031	1	4.792500	4.792500	2106.651026	2433.660000	2116.531290	0.813067	0.0	0.0
12	HRQTRO3U	1	4.971500	4.971500	2106.781051	2433.660000	2116.654312	0.813067	0.0	0.0
13	HRQTRO3D	1	5.150500	5.150500	2106.911077	2433.660000	2116.777334	0.813067	0.0	0.0
14	HRDRI032	1	5.376500	5.376500	2107.075243	2433.660000	2116.932658	0.813067	0.0	0.0
15	HRUMA03U	1	5.444500	5.444500	2107.124638	2433.660000	2116.979392	0.813067	0.0	0.0
16	HRUMA03D	1	5.506500	5.506500	2107.169674	2433.660000	2117.022003	0.813067	0.0	0.0
17	HRDRI033	1	6.015500	6.015500	2107.539411	2433.660000	2117.371826	0.813067	0.0	0.0
18	HRXNV03U	1	6.138500	6.138500	2107.628758	2433.660000	2117.456360	0.813067	0.0	0.0
19	HRXNV03D	1	6.261500	6.261500	2107.718105	2433.660000	2117.540895	0.813067	0.0	0.0
20	HRDRI034	1	6.534340	6.534340	2107.916296	2433.660000	2117.728411	0.813067	0.0	0.0
21	HRCLE03	1	6.534340	6.534340	2107.916296	2433.660000	2117.728411	0.813067	0.0	0.0
22	HRDRI035	1	6.735950	6.735950	2108.062745	2433.660000	2117.866972	0.813067	0.0	0.0
23	HRBHZO4	1	7.325050	7.325050	2108.401272	2433.660000	2118.344467	0.420368	0.0	0.0
24	HRDRI041	1	7.772500	7.772500	2108.583875	2433.660000	2118.752961	0.420368	0.0	0.0
25	HRQFLO4U	1	7.962500	7.962500	2108.661413	2433.660000	2118.926420	0.420368	0.0	0.0
26	HRQFLO4D	1	8.152500	8.152500	2108.738951	2433.660000	2119.099878	0.420368	0.0	0.0
27	HRDRI051	1	8.442000	8.442000	2108.857095	2433.660000	2119.364174	0.420368	0.0	0.0
28	HRXNHO5U	1	8.565000	8.565000	2108.907291	2433.660000	2119.476466	0.420368	0.0	0.0
29	HRXNHO5D	1	8.688000	8.688000	2108.957487	2433.660000	2119.588757	0.420368	0.0	0.0
30	HRDRI052	1	8.843500	8.843500	2109.020946	2433.660000	2119.730719	0.420368	0.0	0.0
31	HRUMA05U	1	8.911500	8.911500	2109.048696	2433.660000	2119.792799	0.420368	0.0	0.0
32	HRUMA05D	1	8.973500	8.973500	2109.073998	2433.660000	2119.849401	0.420368	0.0	0.0
33	HRDRI053	1	9.177500	9.177500	2109.157250	2433.660000	2120.035641	0.420368	0.0	0.0
34	HRQFLO6U	1	9.367500	9.367500	2109.234788	2433.660000	2120.209099	0.420368	0.0	0.0
35	HRQFLO6D	1	9.557500	9.557500	2109.312327	2433.660000	2120.382557	0.420368	0.0	0.0
36	HRDRI061	1	9.803340	9.803340	2109.412653	2433.660000	2120.606994	0.420368	0.0	0.0
37	HRCLE06	1	9.803340	9.803340	2109.412653	2433.660000	2120.606994	0.420368	0.0	0.0
38	HRDRI062	1	10.004950	10.004950	2109.494929	2433.660000	2120.791052	0.420368	0.0	0.0
39	HRBHZO6	1	10.594050	10.594050	2109.624958	2433.660000	2121.361748	0.027669	0.0	0.0
40	HRDRI071	1	11.068500	11.068500	2109.638084	2433.660000	2121.836017	0.027669	0.0	0.0
41	HRXNVO7U	1	11.191500	11.191500	2109.641487	2433.660000	2121.958970	0.027669	0.0	0.0
42	HRXNVO7D	1	11.314500	11.314500	2109.644890	2433.660000	2122.081923	0.027669	0.0	0.0
43	HRDRI072	1	12.179500	12.179500	2109.668820	2433.660000	2122.946591	0.027669	0.0	0.0
44	HRQTRO7U	1	12.358500	12.358500	2109.673772	2433.660000	2123.125523	0.027669	0.0	0.0
45	HRQTRO7D	1	12.537500	12.537500	2109.678724	2433.660000	2123.304454	0.027669	0.0	0.0
46	HRDRI073	1	12.783340	12.783340	2109.685525	2433.660000	2123.550200	0.027669	0.0	0.0
47	HRCLE07	1	12.783340	12.783340	2109.685525	2433.660000	2123.550200	0.027669	0.0	0.0
48	HRDRI074	1	12.984950	12.984950	2109.691103	2433.660000	2123.751733	0.027669	0.0	0.0
49	HRBHZO8	1	13.574050	13.574050	2109.592838	2433.660000	2124.328748	0.365030	0.0	0.0

Table 1. Geometry of EPA

POS. NO.	ELEMENT OCC. NO.	ELEMENT NAME	SEQUENCE SUM(L) [M]	ARC [M]	I I I	POSITIONS X [M]	Y [M]	Z [M]	I I I	THETA [RAD]	ANGLES PHI [RAD]	PSI [RAD]
50	1	HRDRI081	14.021500	14.021500	1	2109.433108	2433.660000	2124.746717	1	-0.365030	0.0	0.0
51	1	HRQFW08U	14.211500	14.211500	1	2109.365283	2433.660000	2124.924198	1	-0.365030	0.0	0.0
52	1	HRQFW08D	14.401500	14.401500	1	2109.297457	2433.660000	2125.101679	1	-0.365030	0.0	0.0
53	1	HRDRI111	14.685500	14.685500	1	2109.196075	2433.660000	2125.366968	1	-0.365030	0.0	0.0
54	1	HRUMA11U	14.753500	14.753500	1	2109.171801	2433.660000	2125.430487	1	-0.365030	0.0	0.0
55	1	HRUMA11D	14.815500	14.815500	1	2109.149668	2433.660000	2125.488402	1	-0.365030	0.0	0.0
56	1	HRDRI112	15.296500	15.296500	1	2108.977962	2433.660000	2125.937711	1	-0.365030	0.0	0.0
57	1	HRVVS11U	15.366500	15.366500	1	2108.952973	2433.660000	2126.003098	1	-0.365030	0.0	0.0
58	1	HRVVS11D	15.436500	15.436500	1	2108.927985	2433.660000	2126.068486	1	-0.365030	0.0	0.0
59	1	HRDRI113	15.436500	15.436500	1	2108.927985	2433.660000	2126.068486	1	-0.365030	0.0	0.0
60	1	HRSLH11U	15.536500	15.536500	1	2108.892287	2433.660000	2126.161898	1	-0.365030	0.0	0.0
61	1	HRSLH11D	15.636500	15.636500	1	2108.856589	2433.660000	2126.255309	1	-0.365030	0.0	0.0
62	1	HRDRI114	16.954000	16.954000	1	2108.386271	2433.660000	2127.486003	1	-0.365030	0.0	0.0
63	1	HRKFI11U	17.137000	17.137000	1	2108.320945	2433.660000	2127.656945	1	-0.365030	0.0	0.0
64	1	HRKFI11D	17.167000	17.167000	1	2108.310235	2433.660000	2127.684969	1	-0.365030	0.0	0.0
65	1	HRKFD11D	17.197000	17.197000	1	2108.299526	2433.660000	2127.712992	1	-0.365030	0.0	0.0
66	1	HRKFI11D	17.380000	17.380000	1	2108.234199	2433.660000	2127.883935	1	-0.365030	0.0	0.0
67	1	HRDRI115	17.706500	17.706500	1	2108.117646	2433.660000	2128.188923	1	-0.365030	0.0	0.0
68	1	HRQCB11U	17.783000	17.783000	1	2108.090337	2433.660000	2128.260382	1	-0.365030	0.0	0.0
69	1	HRQCB11D	17.859500	17.859500	1	2108.063028	2433.660000	2128.331842	1	-0.365030	0.0	0.0
70	1	HRDRI116	18.087500	18.087500	1	2107.981637	2433.660000	2128.544820	1	-0.365030	0.0	0.0
71	1	HRQFN12U	18.266500	18.266500	1	2107.917738	2433.660000	2128.712026	1	-0.365030	0.0	0.0
72	1	HRQFN12D	18.445500	18.445500	1	2107.853839	2433.660000	2128.879232	1	-0.365030	0.0	0.0
73	1	HRDRI121	18.595500	18.595500	1	2107.800293	2433.660000	2129.019349	1	-0.365030	0.0	0.0
74	1	HRBSW12U	18.763000	18.763000	1	2107.740499	2433.660000	2129.175813	1	-0.365030	0.0	0.0
75	1	HRBSW12D	18.930500	18.930500	1	2107.680705	2433.660000	2129.332277	1	-0.365030	0.0	0.0
76	1	HRDRI122	20.360800	20.360800	1	2107.170120	2433.660000	2130.668339	1	-0.365030	0.0	0.0
77	1	HRCLE12	20.360800	20.360800	1	2107.170120	2433.660000	2130.668339	1	-0.365030	0.0	0.0
78	1	HRDRI123	20.839800	20.839800	1	2106.999128	2433.660000	2131.115779	1	-0.365030	0.0	0.0
79	1	HRQDN12U	21.018800	21.018800	1	2106.935229	2433.660000	2131.282985	1	-0.365030	0.0	0.0
80	1	HRQDN12D	21.197800	21.197800	1	2106.871330	2433.660000	2131.450191	1	-0.365030	0.0	0.0
81	1	HRDRI131	22.490800	22.490800	1	2106.409758	2433.660000	2132.657999	1	-0.365030	0.0	0.0
82	1	HRUMA13U	22.558800	22.558800	1	2106.385483	2433.660000	2132.721519	1	-0.365030	0.0	0.0
83	1	HRUMA13D	22.620800	22.620800	1	2106.363351	2433.660000	2132.779434	1	-0.365030	0.0	0.0
84	1	HRDRI132	22.852800	22.852800	1	2106.280532	2433.660000	2132.996148	1	-0.365030	0.0	0.0
85	1	HRQDN14U	23.031800	23.031800	1	2106.216633	2433.660000	2133.163354	1	-0.365030	0.0	0.0
86	1	HRQDN14D	23.210800	23.210800	1	2106.152734	2433.660000	2133.330561	1	-0.365030	0.0	0.0
87	1	HRDRI141	24.643100	24.643100	1	2105.641435	2433.660000	2134.668491	1	-0.365030	0.0	0.0
88	1	HRCLE14	24.643100	24.643100	1	2105.641435	2433.660000	2134.668491	1	-0.365030	0.0	0.0
89	1	HRDRI142	25.249100	25.249100	1	2105.425106	2433.660000	2135.234563	1	-0.365030	0.0	0.0
90	1	HRWBS14U	25.319100	25.319100	1	2105.400118	2433.660000	2135.299951	1	-0.365030	0.0	0.0
91	1	HRWBS14D	25.389100	25.389100	1	2105.375129	2433.660000	2135.365339	1	-0.365030	0.0	0.0
92	1	HRDRI143	25.594100	25.594100	1	2105.301949	2433.660000	2135.556832	1	-0.365030	0.0	0.0
93	1	HRQFI14U	25.784100	25.784100	1	2105.234123	2433.660000	2135.734313	1	-0.365030	0.0	0.0
94	1	HRQFI14D	25.974100	25.974100	1	2105.166298	2433.660000	2135.911795	1	-0.365030	0.0	0.0
95	1	HRDRI211	27.072100	27.072100	1	2104.774336	2433.660000	2136.937451	1	-0.365030	0.0	0.0
96	1	HRSEH21U	27.197100	27.197100	1	2104.729714	2433.660000	2137.054215	1	-0.365030	0.0	0.0
97	1	HRSEH21D	27.322100	27.322100	1	2104.685092	2433.660000	2137.170979	1	-0.365030	0.0	0.0
98	1	HRDRI212	27.467100	27.467100	1	2104.633330	2433.660000	2137.306425	1	-0.365030	0.0	0.0
99	1	HRQFI22U	27.657100	27.657100	1	2104.565504	2433.660000	2137.483907	1	-0.365030	0.0	0.0

Table 1. (cont.)

POS. NO.	ELEMENT NAME	ELEMENT OCC. NO.	SEQUENCE SUM(L) [M]	ARC [M]	POSITIONS X [M]	Y [M]	Z [M]	THETA [RAD]	ANGLES PHI [RAD]	PSI [RAD]
100	HRQFI22D	1	27.847100	27.847100	2104.497678	2433.660000	2137.661388	-0.365030	0.0	0.0
101	HRDRI221	1	28.423100	28.423100	2104.292059	2433.660000	2138.199437	-0.365030	0.0	0.0
102	HRCLE22	1	28.423100	28.423100	2104.292059	2433.660000	2138.199437	-0.365030	0.0	0.0
103	HRDRI222	1	30.230400	30.230400	2103.646894	2433.660000	2139.887660	-0.365030	0.0	0.0
104	HRQDN22U	1	30.409400	30.409400	2103.582995	2433.660000	2140.054866	-0.365030	0.0	0.0
105	HRQDN22D	1	30.588400	30.588400	2103.519096	2433.660000	2140.222072	-0.365030	0.0	0.0
106	HRDRI231	1	31.881400	31.881400	2103.057524	2433.660000	2141.429880	-0.365030	0.0	0.0
107	HRUMA23U	1	31.949400	31.949400	2103.033249	2433.660000	2141.493400	-0.365030	0.0	0.0
108	HRUMA23D	1	32.011400	32.011400	2103.011117	2433.660000	2141.551315	-0.365030	0.0	0.0
109	HRDRI232	1	32.243400	32.243400	2102.928298	2433.660000	2141.768029	-0.365030	0.0	0.0
110	HRQDN24U	1	32.422400	32.422400	2102.864399	2433.660000	2141.935235	-0.365030	0.0	0.0
111	HRQDN24D	1	32.601400	32.601400	2102.800500	2433.660000	2142.102442	-0.365030	0.0	0.0
112	HRDRI241	1	34.995700	34.995700	2101.945788	2433.660000	2144.338988	-0.365030	0.0	0.0
113	HRQFN24U	1	35.174700	35.174700	2101.881889	2433.660000	2144.506194	-0.365030	0.0	0.0
114	HRQFN24D	1	35.353700	35.353700	2101.817990	2433.660000	2144.673401	-0.365030	0.0	0.0
115	HRDRI311	1	35.735200	35.735200	2101.681803	2433.660000	2145.029765	-0.365030	0.0	0.0
116	HRKFI31U	1	35.918200	35.918200	2101.616476	2433.660000	2145.200707	-0.365030	0.0	0.0
117	HRKFD31U	1	35.948200	35.948200	2101.605767	2433.660000	2145.228731	-0.365030	0.0	0.0
118	HRKFD31D	1	35.978200	35.978200	2101.595058	2433.660000	2145.256754	-0.365030	0.0	0.0
119	HRKFI31D	1	36.161200	36.161200	2101.529731	2433.660000	2145.427697	-0.365030	0.0	0.0
120	HRDRI312	1	36.487700	36.487700	2101.413178	2433.660000	2145.732685	-0.365030	0.0	0.0
121	HRQCB31U	1	36.564200	36.564200	2101.385869	2433.660000	2145.804144	-0.365030	0.0	0.0
122	HRQCB31D	1	36.640700	36.640700	2101.358560	2433.660000	2145.875604	-0.365030	0.0	0.0
123	HRDRI313	1	36.868700	36.868700	2101.277169	2433.660000	2146.088582	-0.365030	0.0	0.0
124	HRQFN32U	1	37.047700	37.047700	2101.213270	2433.660000	2146.255788	-0.365030	0.0	0.0
125	HRQFN32D	1	37.226700	37.226700	2101.149371	2433.660000	2146.422994	-0.365030	0.0	0.0
126	HRDRI321	1	37.376700	37.376700	2101.095825	2433.660000	2146.563111	-0.365030	0.0	0.0
127	HRBSW32U	1	37.544200	37.544200	2101.036031	2433.660000	2146.719575	-0.365030	0.0	0.0
128	HRBSW32D	1	37.711700	37.711700	2100.976237	2433.660000	2146.876039	-0.365030	0.0	0.0
129	HRDRI322	1	39.142000	39.142000	2100.465652	2433.660000	2148.212101	-0.365030	0.0	0.0
130	HRCLE32	1	39.142000	39.142000	2100.465652	2433.660000	2148.212101	-0.365030	0.0	0.0
131	HRDRI323	1	39.621000	39.621000	2100.294660	2433.660000	2148.659541	-0.365030	0.0	0.0
132	HRQDN32U	1	39.800000	39.800000	2100.230761	2433.660000	2148.826747	-0.365030	0.0	0.0
133	HRQDN32D	1	39.979000	39.979000	2100.166862	2433.660000	2148.993953	-0.365030	0.0	0.0
134	HRDRI331	1	40.211000	40.211000	2100.084043	2433.660000	2149.210667	-0.365030	0.0	0.0
135	HRUMA33U	1	40.279000	40.279000	2100.059768	2433.660000	2149.274187	-0.365030	0.0	0.0
136	HRUMA33D	1	40.341000	40.341000	2100.037636	2433.660000	2149.332102	-0.365030	0.0	0.0
137	HRDRI332	1	41.634000	41.634000	2099.576064	2433.660000	2150.539910	-0.365030	0.0	0.0
138	HRQDN34U	1	41.813000	41.813000	2099.512165	2433.660000	2150.707116	-0.365030	0.0	0.0
139	HRQDN34D	1	41.992000	41.992000	2099.448266	2433.660000	2150.874322	-0.365030	0.0	0.0
140	HRDRI341	1	43.907300	43.907300	2098.764546	2433.660000	2152.663429	-0.365030	0.0	0.0
141	HRCLE34	1	43.907300	43.907300	2098.764546	2433.660000	2152.663429	-0.365030	0.0	0.0
142	HRDRI342	1	44.386300	44.386300	2098.593554	2433.660000	2153.110869	-0.365030	0.0	0.0
143	HRQFN34U	1	44.565300	44.565300	2098.529655	2433.660000	2153.278075	-0.365030	0.0	0.0
144	HRQFN34D	1	44.744300	44.744300	2098.465756	2433.660000	2153.445281	-0.365030	0.0	0.0
145	HRDRI411	1	46.964300	46.964300	2097.673266	2433.660000	2155.519012	-0.365030	0.0	0.0
146	HRCLE41	1	46.964300	46.964300	2097.673266	2433.660000	2155.519012	-0.365030	0.0	0.0
147	HRDRI412	1	47.372300	47.372300	2097.527619	2433.660000	2155.900130	-0.365030	0.0	0.0
148	HRVVS41U	1	47.442300	47.442300	2097.502631	2433.660000	2155.965518	-0.365030	0.0	0.0
149	HRVVS41D	1	47.512300	47.512300	2097.477642	2433.660000	2156.030906	-0.365030	0.0	0.0

Table 1. (cont.)

POS. NO.	ELEMENT OCC. NO.	ELEMENT NAME	SEQUENCE SUM(L) [M]	ARC [M]	POSITIONS X [M]	Y [M]	Z [M]	ANGLES THETA [RAD]	PHI [RAD]	PSI [RAD]
150	1	HRDRI413	48.016300	48.016300	2097.297725	2433.660000	2156.501699	-0.365030	0.0	0.0
151	1	HRUMA41U	48.084300	48.084300	2097.273451	2433.660000	2156.565219	-0.365030	0.0	0.0
152	1	HRUMA41D	48.146300	48.146300	2097.251318	2433.660000	2156.623134	-0.365030	0.0	0.0
153	1	HRDRI414	48.430300	48.430300	2097.149937	2433.660000	2156.888422	-0.365030	0.0	0.0
154	1	HRQFW42U	48.620300	48.620300	2097.082111	2433.660000	2157.065903	-0.365030	0.0	0.0
155	1	HRQFW42D	48.810300	48.810300	2097.014285	2433.660000	2157.243385	-0.365030	0.0	0.0
156	1	HRDRI421	49.056140	49.056140	2096.926526	2433.660000	2157.473027	-0.365030	0.0	0.0
157	1	HRCLE42	49.056140	49.056140	2096.926526	2433.660000	2157.473027	-0.365030	0.0	0.0
158	1	HRDRI422	49.257750	49.257750	2096.854556	2433.660000	2157.661353	-0.365030	0.0	0.0
159	1	HRBHZ42	49.846850	49.846850	2096.542957	2433.660000	2158.156841	-0.757729	0.0	0.0
160	1	HRDRI431	50.294300	50.294300	2096.235436	2433.660000	2158.481868	-0.757729	0.0	0.0
161	1	HRQTR43U	50.473300	50.473300	2096.112414	2433.660000	2158.611893	-0.757729	0.0	0.0
162	1	HRQTR43D	50.652300	50.652300	2095.989392	2433.660000	2158.741919	-0.757729	0.0	0.0
163	1	HRDRI432	51.517300	51.517300	2095.395045	2433.660000	2159.370253	-0.757729	0.0	0.0
164	1	HRXNV43U	51.640300	51.640300	2095.310365	2433.660000	2159.459600	-0.757729	0.0	0.0
165	1	HRXNV43D	51.763300	51.763300	2095.225831	2433.660000	2159.548947	-0.757729	0.0	0.0
166	1	HRDRI433	52.036140	52.036140	2095.038315	2433.660000	2159.747138	-0.757729	0.0	0.0
167	1	HRCLE43	52.036140	52.036140	2095.038315	2433.660000	2159.747138	-0.757729	0.0	0.0
168	1	HRDRI434	52.237750	52.237750	2094.899753	2433.660000	2159.893587	-0.757729	0.0	0.0
169	1	HRBHZ44	52.826850	52.826850	2094.422259	2433.660000	2160.232114	-1.150428	0.0	0.0
170	1	HRDRI441	53.274300	53.274300	2094.013764	2433.660000	2160.414717	-1.150428	0.0	0.0
171	1	HRQFL44U	53.464300	53.464300	2093.840306	2433.660000	2160.492255	-1.150428	0.0	0.0
172	1	HRQFL44D	53.654300	53.654300	2093.666847	2433.660000	2160.569793	-1.150428	0.0	0.0
173	1	HRDRI451	53.858300	53.858300	2093.480644	2433.660000	2160.653045	-1.150428	0.0	0.0
174	1	HRUMA45U	53.926300	53.926300	2093.418528	2433.660000	2160.680796	-1.150428	0.0	0.0
175	1	HRUMA45D	53.988300	53.988300	2093.361926	2433.660000	2160.706098	-1.150428	0.0	0.0
176	1	HRDRI452	54.143800	54.143800	2093.219964	2433.660000	2160.769556	-1.150428	0.0	0.0
177	1	HRXNH45U	54.266800	54.266800	2093.107672	2433.660000	2160.819752	-1.150428	0.0	0.0
178	1	HRXNH45D	54.389800	54.389800	2092.995381	2433.660000	2160.869948	-1.150428	0.0	0.0
179	1	HRDRI453	54.679300	54.679300	2092.731085	2433.660000	2160.988092	-1.150428	0.0	0.0
180	1	HRQFL46U	54.869300	54.869300	2092.557627	2433.660000	2161.065630	-1.150428	0.0	0.0
181	1	HRQFL46D	55.059300	55.059300	2092.384168	2433.660000	2161.143169	-1.150428	0.0	0.0
182	1	HRDRI461	55.305140	55.305140	2092.159731	2433.660000	2161.243495	-1.150428	0.0	0.0
183	1	HRCLE46	55.305140	55.305140	2092.159731	2433.660000	2161.243495	-1.150428	0.0	0.0
184	1	HRDRI462	55.506750	55.506750	2091.975674	2433.660000	2161.325771	-1.150428	0.0	0.0
185	1	HRBHZ46	56.095850	56.095850	2091.404977	2433.660000	2161.455800	-1.543128	0.0	0.0
186	1	HRDRI471	56.570300	56.570300	2090.930709	2433.660000	2161.468926	-1.543128	0.0	0.0
187	1	HRXNV47U	56.693300	56.693300	2090.807756	2433.660000	2161.472329	-1.543128	0.0	0.0
188	1	HRXNV47D	56.816300	56.816300	2090.684803	2433.660000	2161.475732	-1.543128	0.0	0.0
189	1	HRDRI472	57.325300	57.325300	2090.176004	2433.660000	2161.489813	-1.543128	0.0	0.0
190	1	HRUMA47U	57.393300	57.393300	2090.108024	2433.660000	2161.491694	-1.543128	0.0	0.0
191	1	HRUMA47D	57.455300	57.455300	2090.046048	2433.660000	2161.493410	-1.543128	0.0	0.0
192	1	HRDRI473	57.681300	57.681300	2089.820134	2433.660000	2161.499662	-1.543128	0.0	0.0
193	1	HRQTR47U	57.860300	57.860300	2089.641203	2433.660000	2161.504614	-1.543128	0.0	0.0
194	1	HRQTR47D	58.039300	58.039300	2089.462271	2433.660000	2161.509566	-1.543128	0.0	0.0
195	1	HRDRI474	58.285140	58.285140	2089.216525	2433.660000	2161.516367	-1.543128	0.0	0.0
196	1	HRCLE47	58.285140	58.285140	2089.216525	2433.660000	2161.516367	-1.543128	0.0	0.0
197	1	HRDRI475	58.486750	58.486750	2089.014992	2433.660000	2161.521945	-1.543128	0.0	0.0
198	1	HRBHZ48	59.075850	59.075850	2088.437978	2433.660000	2161.423680	-1.935827	0.0	0.0
199	1	HRDRI481	59.523300	59.523300	2088.020009	2433.660000	2161.263950	-1.935827	0.0	0.0

Table 1. (cont.)

POS. NO.	ELEMENT NAME	OCC. NO.	SEQUENCE SUM(L) [M]	ARC [M]	POSITIONS X [M]	POSITIONS Y [M]	POSITIONS Z [M]	THETA [RAD]	ANGLES PHI [RAD]	PSI [RAD]
200	HRQFW48U	1	59.713300	59.713300	2087.842528	2433.660000	2161.196125	-1.935827	0.0	0.0
201	HRQFW48D	1	59.903300	59.903300	2087.665046	2433.660000	2161.128299	-1.935827	0.0	0.0
202	HRDRI491	1	60.356800	60.356800	2087.241426	2433.660000	2160.966409	-1.935827	0.0	0.0
203	HRKFE49U	1	60.539800	60.539800	2087.070483	2433.660000	2160.901083	-1.935827	0.0	0.0
204	HRKFD49U	1	60.569800	60.569800	2087.042460	2433.660000	2160.890373	-1.935827	0.0	0.0
205	HRKFD49D	1	60.599800	60.599800	2087.014436	2433.660000	2160.879664	-1.935827	0.0	0.0
206	HRKFE49D	1	60.782800	60.782800	2086.843494	2433.660000	2160.814337	-1.935827	0.0	0.0
207	HRDRI492	1	61.186300	61.186300	2086.466579	2433.660000	2160.670297	-1.935827	0.0	0.0
208	HRVVS49U	1	61.256300	61.256300	2086.401191	2433.660000	2160.645308	-1.935827	0.0	0.0
209	HRVVS49D	1	61.326300	61.326300	2086.335803	2433.660000	2160.620320	-1.935827	0.0	0.0
210	HRDRI493	1	62.593800	62.593800	2085.151815	2433.660000	2160.167851	-1.935827	0.0	0.0
211	HRUMA49U	1	62.661800	62.661800	2085.088296	2433.660000	2160.143576	-1.935827	0.0	0.0
212	HRUMA49D	1	62.723800	62.723800	2085.030381	2433.660000	2160.121443	-1.935827	0.0	0.0
213	HRDRI494	1	62.831800	62.831800	2084.929496	2433.660000	2160.082890	-1.935827	0.0	0.0
214	HRDRI511	1	64.880800	64.880800	2083.015499	2433.660000	2159.351443	-1.935827	0.0	0.0
215	HRKFE511	1	65.063800	65.063800	2082.844556	2433.660000	2159.286116	-1.935827	0.0	0.0
216	HRKFD51U	1	65.093800	65.093800	2082.816533	2433.660000	2159.275406	-1.935827	0.0	0.0
217	HRKFD51D	1	65.123800	65.123800	2082.788510	2433.660000	2159.264697	-1.935827	0.0	0.0
218	HRKFE51D	1	65.306800	65.306800	2082.617567	2433.660000	2159.199370	-1.935827	0.0	0.0
219	HRDRI512	1	65.760300	65.760300	2082.193947	2433.660000	2159.037481	-1.935827	0.0	0.0
220	HRQFW52U	1	65.950300	65.950300	2082.016465	2433.660000	2158.969655	-1.935827	0.0	0.0
221	HRQFW52D	1	66.140300	66.140300	2081.838984	2433.660000	2158.901829	-1.935827	0.0	0.0
222	HRDRI521	1	66.386140	66.386140	2081.609341	2433.660000	2158.814070	-1.935827	0.0	0.0
223	HRCLE52	1	66.386140	66.386140	2081.609341	2433.660000	2158.814070	-1.935827	0.0	0.0
224	HRDRI522	1	66.587750	66.587750	2081.421015	2433.660000	2158.742100	-1.935827	0.0	0.0
225	HRBHZ52	1	67.176850	67.176850	2080.925527	2433.660000	2158.430501	-2.328526	0.0	0.0
226	HRDRI531	1	67.624300	67.624300	2080.600500	2433.660000	2158.122980	-2.328526	0.0	0.0
227	HRQTR53U	1	67.803300	67.803300	2080.470475	2433.660000	2157.999958	-2.328526	0.0	0.0
228	HRQTR53D	1	67.982300	67.982300	2080.340450	2433.660000	2157.876936	-2.328526	0.0	0.0
229	HRDRI532	1	68.206300	68.206300	2080.176284	2433.660000	2157.721612	-2.328526	0.0	0.0
230	HRUMA53U	1	68.276300	68.276300	2080.126889	2433.660000	2157.674878	-2.328526	0.0	0.0
231	HRUMA53D	1	68.338300	68.338300	2080.081852	2433.660000	2157.632267	-2.328526	0.0	0.0
232	HRDRI533	1	68.847300	68.847300	2079.712115	2433.660000	2157.282444	-2.328526	0.0	0.0
233	HRXNV53U	1	68.970300	68.970300	2079.622768	2433.660000	2157.197909	-2.328526	0.0	0.0
234	HRXNV53D	1	69.093300	69.093300	2079.533421	2433.660000	2157.113375	-2.328526	0.0	0.0
235	HRDRI534	1	69.366140	69.366140	2079.335231	2433.660000	2156.925859	-2.328526	0.0	0.0
236	HRCLE53	1	69.366140	69.366140	2079.335231	2433.660000	2156.925859	-2.328526	0.0	0.0
237	HRDRI535	1	69.567750	69.567750	2079.188781	2433.660000	2156.787298	-2.328526	0.0	0.0
238	HRBHZ54	1	70.156850	70.156850	2078.850254	2433.660000	2156.309803	-2.721225	0.0	0.0
239	HRDRI541	1	70.604300	70.604300	2078.667652	2433.660000	2155.901308	-2.721225	0.0	0.0
240	HRQFL54U	1	70.794300	70.794300	2078.590113	2433.660000	2155.727850	-2.721225	0.0	0.0
241	HRQFL54D	1	70.984300	70.984300	2078.512575	2433.660000	2155.554392	-2.721225	0.0	0.0
242	HRDRI551	1	71.273800	71.273800	2078.394431	2433.660000	2155.290096	-2.721225	0.0	0.0
243	HRXNH55U	1	71.396800	71.396800	2078.344235	2433.660000	2155.177804	-2.721225	0.0	0.0
244	HRXNH55D	1	71.519800	71.519800	2078.294040	2433.660000	2155.065513	-2.721225	0.0	0.0
245	HRDRI552	1	71.675300	71.675300	2078.230581	2433.660000	2154.923551	-2.721225	0.0	0.0
246	HRUMA55U	1	71.743300	71.743300	2078.202830	2433.660000	2154.861471	-2.721225	0.0	0.0
247	HRUMA55D	1	71.805300	71.805300	2078.177528	2433.660000	2154.804869	-2.721225	0.0	0.0
248	HRDRI553	1	72.009300	72.009300	2078.094276	2433.660000	2154.618629	-2.721225	0.0	0.0
249	HRQFL56U	1	72.199300	72.199300	2078.016738	2433.660000	2154.445171	-2.721225	0.0	0.0

Table 1. (cont.)

POS. NO.	ELEMENT NAME	OCC. NO.	SUM(L) [M]	ARC [M]	X [M]	Y [M]	Z [M]	THETA [RAD]	PHI [RAD]	PSI [RAD]
250	HRQFL56D	1	72.389300	72.389300	2077.939200	2433.660000	2154.271712	-2.721225	0.0	0.0
251	HRDRI561	1	72.635140	72.635140	2077.838873	2433.660000	2154.047276	-2.721225	0.0	0.0
252	HRCLE56	1	72.635140	72.635140	2077.838873	2433.660000	2154.047276	-2.721225	0.0	0.0
253	HRDRI562	1	72.836750	72.836750	2077.756597	2433.660000	2153.863218	-2.721225	0.0	0.0
254	HRBHZ56	1	73.425850	73.425850	2077.626568	2433.660000	2153.292522	-3.113924	0.0	0.0
255	HRDRI571	1	73.900300	73.900300	2077.613442	2433.660000	2152.818253	-3.113924	0.0	0.0
256	HRXNV57U	1	74.023300	74.023300	2077.610040	2433.660000	2152.695300	-3.113924	0.0	0.0
257	HRXNV57D	1	74.146300	74.146300	2077.606637	2433.660000	2152.572347	-3.113924	0.0	0.0
258	HRDRI572	1	75.011300	75.011300	2077.582706	2433.660000	2151.707678	-3.113924	0.0	0.0
259	HRQTR57U	1	75.190300	75.190300	2077.577754	2433.660000	2151.528747	-3.113924	0.0	0.0
260	HRQTR57D	1	75.369300	75.369300	2077.572802	2433.660000	2151.349815	-3.113924	0.0	0.0
261	HRDRI573	1	75.615140	75.615140	2077.566001	2433.660000	2151.104070	-3.113924	0.0	0.0
262	HRCLE57	1	75.615140	75.615140	2077.566001	2433.660000	2151.104070	-3.113924	0.0	0.0
263	HRDRI574	1	75.816750	75.816750	2077.560423	2433.660000	2150.902537	-3.113924	0.0	0.0
264	HRBHZ58	1	76.405850	76.405850	2077.658688	2433.660000	2150.325522	-3.506623	0.0	0.0
265	HRDRI581	1	76.853300	76.853300	2077.818418	2433.660000	2149.907553	-3.506623	0.0	0.0
266	HRQFW58U	1	77.043300	77.043300	2077.886244	2433.660000	2149.730072	-3.506623	0.0	0.0
267	HRQFW58D	1	77.233300	77.233300	2077.954070	2433.660000	2149.552590	-3.506623	0.0	0.0
268	HRDRI611	1	77.517300	77.517300	2078.055451	2433.660000	2149.287302	-3.506623	0.0	0.0
269	HRUMA61U	1	77.585300	77.585300	2078.079726	2433.660000	2149.223783	-3.506623	0.0	0.0
270	HRUMA61D	1	77.647300	77.647300	2078.101858	2433.660000	2149.165868	-3.506623	0.0	0.0
271	HRDRI612	1	78.151300	78.151300	2078.281775	2433.660000	2148.695075	-3.506623	0.0	0.0
272	HRVVS61U	1	78.221300	78.221300	2078.306763	2433.660000	2148.629687	-3.506623	0.0	0.0
273	HRVVS61D	1	78.291300	78.291300	2078.331752	2433.660000	2148.564299	-3.506623	0.0	0.0
274	HRDRI613	1	78.699300	78.699300	2078.477399	2433.660000	2148.183181	-3.506623	0.0	0.0
275	HRCLE61	1	78.699300	78.699300	2078.477399	2433.660000	2148.183181	-3.506623	0.0	0.0
276	HRDRI614	1	80.919300	80.919300	2079.269889	2433.660000	2146.109450	-3.506623	0.0	0.0
277	HRQFN62U	1	81.098300	81.098300	2079.333788	2433.660000	2145.942244	-3.506623	0.0	0.0
278	HRQFN62D	1	81.277300	81.277300	2079.397687	2433.660000	2145.775038	-3.506623	0.0	0.0
279	HRDRI621	1	81.756300	81.756300	2079.568679	2433.660000	2145.327598	-3.506623	0.0	0.0
280	HRCLE62	1	81.756300	81.756300	2079.568679	2433.660000	2145.327598	-3.506623	0.0	0.0
281	HRDRI622	1	82.409450	82.409450	2079.801839	2433.660000	2144.717482	-3.506623	0.0	0.0
282	HRUWB62	1	82.539450	82.539450	2079.848246	2433.660000	2144.596047	-3.506623	0.0	0.0
283	HRDRI623	1	82.649450	82.649450	2079.887514	2433.660000	2144.493295	-3.506623	0.0	0.0
284	HRUMA62U	1	82.717450	82.717450	2079.911788	2433.660000	2144.429775	-3.506623	0.0	0.0
285	HRUMA62D	1	82.779450	82.779450	2079.933921	2433.660000	2144.371860	-3.506623	0.0	0.0
286	HRDRI624	1	83.671600	83.671600	2080.252399	2433.660000	2143.538491	-3.506623	0.0	0.0
287	HRQDN62U	1	83.850600	83.850600	2080.316298	2433.660000	2143.371285	-3.506623	0.0	0.0
288	HRQDN62D	1	84.029600	84.029600	2080.380197	2433.660000	2143.204079	-3.506623	0.0	0.0
289	HRDRI631	1	85.322600	85.322600	2080.841769	2433.660000	2141.996271	-3.506623	0.0	0.0
290	HRUMA63U	1	85.390600	85.390600	2080.866043	2433.660000	2141.932751	-3.506623	0.0	0.0
291	HRUMA63D	1	85.452600	85.452600	2080.888176	2433.660000	2141.874836	-3.506623	0.0	0.0
292	HRDRI632	1	85.684600	85.684600	2080.970995	2433.660000	2141.658122	-3.506623	0.0	0.0
293	HRQDN64U	1	85.863600	85.863600	2081.034894	2433.660000	2141.490915	-3.506623	0.0	0.0
294	HRQDN64D	1	86.042600	86.042600	2081.098793	2433.660000	2141.323709	-3.506623	0.0	0.0
295	HRDRI641	1	86.521600	86.521600	2081.269785	2433.660000	2140.876269	-3.506623	0.0	0.0
296	HRCLE64	1	86.521600	86.521600	2081.269785	2433.660000	2140.876269	-3.506623	0.0	0.0
297	HRDRI642	1	88.080900	88.080900	2081.826420	2433.660000	2139.419707	-3.506623	0.0	0.0
298	HRSTP64	1	88.080900	88.080900	2081.826420	2433.660000	2139.419707	-3.506623	0.0	0.0
299	HRDRI643	1	88.436900	88.436900	2081.953504	2433.660000	2139.087163	-3.506623	0.0	0.0

Table 1. (cont.)

POS. NO.	ELEMENT NAME	ELEMENT OCC. NO.	SEQUENCE SUM(L) [M]	ARC [M]	I I I	X [M]	POSITIONS Y [M]	Z [M]	I I I	THETA [RAD]	ANGLES PHI [RAD]	PSI [RAD]
300	HRQFN64U	1	88.615900	88.615900		2082.017403	2433.660000	2138.919956		-3.506623	0.0	0.0
301	HRQFN64D	1	88.794900	88.794900		2082.081302	2433.660000	2138.752750		-3.506623	0.0	0.0
302	HRDRI711	1	88.931900	88.931900		2082.130208	2433.660000	2138.624777		-3.506623	0.0	0.0
303	HRBSW71U	1	89.099400	89.099400		2082.190002	2433.660000	2138.468313		-3.506623	0.0	0.0
304	HRBSW71D	1	89.266900	89.266900		2082.249796	2433.660000	2138.311849		-3.506623	0.0	0.0
305	HRDRI712	1	89.502400	89.502400		2082.333864	2433.660000	2138.091865		-3.506623	0.0	0.0
306	HRKFI71U	1	89.685400	89.685400		2082.399191	2433.660000	2137.920923		-3.506623	0.0	0.0
307	HRKFD71U	1	89.715400	89.715400		2082.409900	2433.660000	2137.892899		-3.506623	0.0	0.0
308	HRKFD71D	1	89.745400	89.745400		2082.420609	2433.660000	2137.864876		-3.506623	0.0	0.0
309	HRKFI71D	1	89.928400	89.928400		2082.485936	2433.660000	2137.693933		-3.506623	0.0	0.0
310	HRDRI713	1	90.309900	90.309900		2082.622123	2433.660000	2137.337569		-3.506623	0.0	0.0
311	HRQFN72U	1	90.488900	90.488900		2082.686022	2433.660000	2137.170363		-3.506623	0.0	0.0
312	HRQFN72D	1	90.667900	90.667900		2082.749921	2433.660000	2137.003157		-3.506623	0.0	0.0
313	HRDRI721	1	91.865050	91.865050		2083.177277	2433.660000	2135.884883		-3.506623	0.0	0.0
314	HRCRF72	1	91.865050	91.865050		2083.177277	2433.660000	2135.884883		-3.506623	0.0	0.0
315	HRDRI722	1	93.062200	93.062200		2083.604633	2433.660000	2134.766610		-3.506623	0.0	0.0
316	HRQDN72U	1	93.241200	93.241200		2083.668532	2433.660000	2134.599404		-3.506623	0.0	0.0
317	HRQDN72D	1	93.420200	93.420200		2083.732431	2433.660000	2134.432198		-3.506623	0.0	0.0
318	HRDRI731	1	93.652200	93.652200		2083.815250	2433.660000	2134.215483		-3.506623	0.0	0.0
319	HRUMA73U	1	93.720200	93.720200		2083.839524	2433.660000	2134.151964		-3.506623	0.0	0.0
320	HRUMA73D	1	93.782200	93.782200		2083.861657	2433.660000	2134.094049		-3.506623	0.0	0.0
321	HRDRI732	1	95.075200	95.075200		2084.323229	2433.660000	2132.886241		-3.506623	0.0	0.0
322	HRQDN74U	1	95.254200	95.254200		2084.387128	2433.660000	2132.719035		-3.506623	0.0	0.0
323	HRQDN74D	1	95.433200	95.433200		2084.451027	2433.660000	2132.551828		-3.506623	0.0	0.0
324	HRDRI741	1	97.279500	97.279500		2085.110114	2433.660000	2130.827176		-3.506623	0.0	0.0
325	HRCLE74	1	97.279500	97.279500		2085.110114	2433.660000	2130.827176		-3.506623	0.0	0.0
326	HRDRI742	1	97.816500	97.816500		2085.301811	2433.660000	2130.325557		-3.506623	0.0	0.0
327	HRQFI74U	1	98.006500	98.006500		2085.369637	2433.660000	2130.148076		-3.506623	0.0	0.0
328	HRQFI74D	1	98.196500	98.196500		2085.437463	2433.660000	2129.970594		-3.506623	0.0	0.0
329	HRDRI811	1	99.689500	99.689500		2085.970431	2433.660000	2128.575963		-3.506623	0.0	0.0
330	HRQFI82U	1	99.879500	99.879500		2086.038256	2433.660000	2128.398482		-3.506623	0.0	0.0
331	HRQFI82D	1	100.069500	100.069500		2086.106082	2433.660000	2128.221001		-3.506623	0.0	0.0
332	HRDRI821	1	100.274500	100.274500		2086.179262	2433.660000	2128.029507		-3.506623	0.0	0.0
333	HRWBS82U	1	100.344500	100.344500		2086.204251	2433.660000	2127.964119		-3.506623	0.0	0.0
334	HRWBS82D	1	100.414500	100.414500		2086.229239	2433.660000	2127.898732		-3.506623	0.0	0.0
335	HRDRI822	1	101.020500	101.020500		2086.445568	2433.660000	2127.332659		-3.506623	0.0	0.0
336	HRCLE82	1	101.020500	101.020500		2086.445568	2433.660000	2127.332659		-3.506623	0.0	0.0
337	HRDRI823	1	102.452800	102.452800		2086.956867	2433.660000	2125.994729		-3.506623	0.0	0.0
338	HRQDN82U	1	102.631800	102.631800		2087.020766	2433.660000	2125.827523		-3.506623	0.0	0.0
339	HRQDN82D	1	102.810800	102.810800		2087.084665	2433.660000	2125.660317		-3.506623	0.0	0.0
340	HRDRI831	1	103.042800	103.042800		2087.167484	2433.660000	2125.443603		-3.506623	0.0	0.0
341	HRUMA83U	1	103.110800	103.110800		2087.191759	2433.660000	2125.380083		-3.506623	0.0	0.0
342	HRUMA83D	1	103.172800	103.172800		2087.213891	2433.660000	2125.322168		-3.506623	0.0	0.0
343	HRDRI832	1	104.135800	104.135800		2087.557660	2433.660000	2124.422617		-3.506623	0.0	0.0
344	HRTRA83	1	104.135800	104.135800		2087.557660	2433.660000	2124.422617		-3.506623	0.0	0.0
345	HRDRI833	1	104.465800	104.465800		2087.675463	2433.660000	2124.114360		-3.506623	0.0	0.0
346	HRQDN84U	1	104.644800	104.644800		2087.739362	2433.660000	2123.947154		-3.506623	0.0	0.0
347	HRQDN84D	1	104.823800	104.823800		2087.803261	2433.660000	2123.779947		-3.506623	0.0	0.0
348	HRDRI841	1	105.302800	105.302800		2087.974253	2433.660000	2123.332507		-3.506623	0.0	0.0
349	HRCLE84	1	105.302800	105.302800		2087.974253	2433.660000	2123.332507		-3.506623	0.0	0.0

Table 1. (cont.)

POS. NO.	ELEMENT NAME	OCC. NO.	SUM(L) [M]	ARC [M]	X [M]	Y [M]	Z [M]	THETA [RAD]	PHI [RAD]	PSI [RAD]
350	HRDRI842	1	106.138800	106.138800	2088.272686	2433.660000	2122.551589	-3.506623	0.0	0.0
351	HREFT84	1	106.138800	106.138800	2088.272686	2433.660000	2122.551589	-3.506623	0.0	0.0
352	HRDRI843	1	107.218100	107.218100	2088.657972	2433.660000	2121.543401	-3.506623	0.0	0.0
353	HRQFN84U	1	107.397100	107.397100	2088.721871	2433.660000	2121.376195	-3.506623	0.0	0.0
354	HRQFN84D	1	107.576100	107.576100	2088.785770	2433.660000	2121.208988	-3.506623	0.0	0.0
355	HRDRI911	1	107.713100	107.713100	2088.834676	2433.660000	2121.081015	-3.506623	0.0	0.0
356	HRBSW91U	1	107.880600	107.880600	2088.894470	2433.660000	2120.924551	-3.506623	0.0	0.0
357	HRBSW91D	1	108.048100	108.048100	2088.954264	2433.660000	2120.768087	-3.506623	0.0	0.0
358	HRDRI912	1	108.283600	108.283600	2089.038332	2433.660000	2120.548103	-3.506623	0.0	0.0
359	HRKFI91U	1	108.466600	108.466600	2089.103659	2433.660000	2120.377161	-3.506623	0.0	0.0
360	HRKFD91U	1	108.496600	108.496600	2089.114368	2433.660000	2120.349137	-3.506623	0.0	0.0
361	HRKFD91D	1	108.526600	108.526600	2089.125077	2433.660000	2120.321114	-3.506623	0.0	0.0
362	HRKFI91D	1	108.709600	108.709600	2089.190404	2433.660000	2120.150171	-3.506623	0.0	0.0
363	HRDRI913	1	110.204100	110.204100	2089.723907	2433.660000	2118.754140	-3.506623	0.0	0.0
364	HRVVS91U	1	110.274100	110.274100	2089.748896	2433.660000	2118.688752	-3.506623	0.0	0.0
365	HRVVS91D	1	110.344100	110.344100	2089.773884	2433.660000	2118.623364	-3.506623	0.0	0.0
366	HRDRI914	1	110.848100	110.848100	2089.953801	2433.660000	2118.152571	-3.506623	0.0	0.0
367	HRUMA91U	1	110.916100	110.916100	2089.978076	2433.660000	2118.089051	-3.506623	0.0	0.0
368	HRUMA91D	1	110.978100	110.978100	2090.000208	2433.660000	2118.031136	-3.506623	0.0	0.0
369	HRDRI915	1	111.262100	111.262100	2090.101592	2433.660000	2117.765848	-3.506623	0.0	0.0
370	HRQFW92U	1	111.452100	111.452100	2090.169416	2433.660000	2117.588367	-3.506623	0.0	0.0
371	HRQFW92D	1	111.642100	111.642100	2090.237241	2433.660000	2117.410885	-3.506623	0.0	0.0
372	HRDRI921	1	111.887940	111.887940	2090.325001	2433.660000	2117.181243	-3.506623	0.0	0.0
373	HRCLE92	1	111.887940	111.887940	2090.325001	2433.660000	2117.181243	-3.506623	0.0	0.0
374	HRDRI922	1	112.089550	112.089550	2090.396971	2433.660000	2116.992916	-3.506623	0.0	0.0
375	HRBHZ92	1	112.678650	112.678650	2090.708570	2433.660000	2116.497429	-3.899322	0.0	0.0
376	HRDRI931	1	113.126100	113.126100	2091.016091	2433.660000	2116.172402	-3.899322	0.0	0.0
377	HRQTR93U	1	113.305100	113.305100	2091.139113	2433.660000	2116.042376	-3.899322	0.0	0.0
378	HRQTR93D	1	113.484100	113.484100	2091.262135	2433.660000	2115.912351	-3.899322	0.0	0.0
379	HRDRI932	1	114.349100	114.349100	2091.856627	2433.660000	2115.284017	-3.899322	0.0	0.0
380	HRXNV93U	1	114.472100	114.472100	2091.941161	2433.660000	2115.194670	-3.899322	0.0	0.0
381	HRXNV93D	1	114.595100	114.595100	2092.025696	2433.660000	2115.105323	-3.899322	0.0	0.0
382	HRDRI933	1	114.867940	114.867940	2092.213212	2433.660000	2114.907132	-3.899322	0.0	0.0
383	HRCLE93	1	114.867940	114.867940	2092.213212	2433.660000	2114.907132	-3.899322	0.0	0.0
384	HRDRI934	1	115.069550	115.069550	2092.351773	2433.660000	2114.760683	-3.899322	0.0	0.0
385	HRBHZ94	1	115.658650	115.658650	2092.829268	2433.660000	2114.422156	-4.292021	0.0	0.0
386	HRDRI941	1	116.106100	116.106100	2093.237762	2433.660000	2114.239553	-4.292021	0.0	0.0
387	HRQFL94U	1	116.296100	116.296100	2093.411221	2433.660000	2114.162015	-4.292021	0.0	0.0
388	HRQFL94D	1	116.486100	116.486100	2093.584679	2433.660000	2114.084476	-4.292021	0.0	0.0
389	HRDRI951	1	116.690100	116.690100	2093.770919	2433.660000	2114.001225	-4.292021	0.0	0.0
390	HRUMA95U	1	116.758100	116.758100	2093.832998	2433.660000	2113.973474	-4.292021	0.0	0.0
391	HRUMA95D	1	116.820100	116.820100	2093.889601	2433.660000	2113.948172	-4.292021	0.0	0.0
392	HRDRI952	1	116.975600	116.975600	2094.031563	2433.660000	2113.884713	-4.292021	0.0	0.0
393	HRXNH95U	1	117.098600	117.098600	2094.143854	2433.660000	2113.834518	-4.292021	0.0	0.0
394	HRXNH95D	1	117.221600	117.221600	2094.256146	2433.660000	2113.784322	-4.292021	0.0	0.0
395	HRDRI953	1	117.511100	117.511100	2094.520441	2433.660000	2113.666178	-4.292021	0.0	0.0
396	HRQFL96U	1	117.701100	117.701100	2094.693900	2433.660000	2113.588640	-4.292021	0.0	0.0
397	HRQFL96D	1	117.891100	117.891100	2094.867358	2433.660000	2113.511101	-4.292021	0.0	0.0
398	HRDRI961	1	118.136940	118.136940	2095.091795	2433.660000	2113.410775	-4.292021	0.0	0.0
399	HRCLE96	1	118.136940	118.136940	2095.091795	2433.660000	2113.410775	-4.292021	0.0	0.0

Table 1. (cont.)

SURVEY - MADTOT
SURVEY OF BEAM LINE "RING"

POS. NO.	ELEMENT NAME	OCC. NO.	SEQUENCE SUM(L) [M]	ARC [M]	POSITIONS X [M]	Y [M]	Z [M]	THETA [RAD]	ANGLES PHI [RAD]	PSI [RAD]
400	HRDRI962	1	118.338550	118.338550	2095.275853	2433.660000	2113.328499	-4.292021	0.0	0.0
401	HRBHZ96	1	118.927650	118.927650	2095.846549	2433.660000	2113.198470	-4.684720	0.0	0.0
402	HRDRI971	1	119.402100	119.402100	2096.320817	2433.660000	2113.185344	-4.684720	0.0	0.0
403	HRXNV97U	1	119.525100	119.525100	2096.443770	2433.660000	2113.181941	-4.684720	0.0	0.0
404	HRXNV97D	1	119.648100	119.648100	2096.566723	2433.660000	2113.178538	-4.684720	0.0	0.0
405	HRDRI972	1	120.157100	120.157100	2097.075528	2433.660000	2113.164457	-4.684720	0.0	0.0
406	HRUMA97U	1	120.225100	120.225100	2097.143502	2433.660000	2113.162575	-4.684720	0.0	0.0
407	HRUMA97D	1	120.287100	120.287100	2097.205479	2433.660000	2113.160860	-4.684720	0.0	0.0
408	HRDRI973	1	120.513100	120.513100	2097.431392	2433.660000	2113.154608	-4.684720	0.0	0.0
409	HRQTR97U	1	120.692100	120.692100	2097.610324	2433.660000	2113.149656	-4.684720	0.0	0.0
410	HRQTR97D	1	120.871100	120.871100	2097.789255	2433.660000	2113.144704	-4.684720	0.0	0.0
411	HRDRI974	1	121.116940	121.116940	2098.035001	2433.660000	2113.137902	-4.684720	0.0	0.0
412	HRCLE97	1	121.116940	121.116940	2098.035001	2433.660000	2113.137902	-4.684720	0.0	0.0
413	HRDRI975	1	121.318550	121.318550	2098.236534	2433.660000	2113.132325	-4.684720	0.0	0.0
414	HRBHZ98	1	121.907650	121.907650	2098.813549	2433.660000	2113.390590	-4.684720	0.0	0.0
415	HRDRI981	1	122.355100	122.355100	2099.231517	2433.660000	2113.390320	-5.077419	0.0	0.0
416	HRQFW98U	1	122.545100	122.545100	2099.408999	2433.660000	2113.458145	-5.077419	0.0	0.0
417	HRQFW98D	1	122.735100	122.735100	2099.586480	2433.660000	2113.525971	-5.077419	0.0	0.0
418	HRDRI991	1	123.324100	123.324100	2100.136673	2433.660000	2113.736231	-5.077419	0.0	0.0
419	HRCLE99	1	123.324100	123.324100	2100.136673	2433.660000	2113.736231	-5.077419	0.0	0.0
420	HRDRI992	1	124.984900	124.984900	2101.688048	2433.660000	2114.329099	-5.077419	0.0	0.0
421	HRVVS99U	1	125.054900	125.054900	2101.753435	2433.660000	2114.354088	-5.077419	0.0	0.0
422	HRVVS99D	1	125.124900	125.124900	2101.818823	2433.660000	2114.379076	-5.077419	0.0	0.0
423	HRDRI993	1	125.456100	125.456100	2102.128202	2433.660000	2114.497307	-5.077419	0.0	0.0
424	HRSMHOOU	1	125.663600	125.663600	2102.322030	2433.660000	2114.571380	-5.077419	0.0	0.0
END	RING		125.663600	125.663600	2102.322030	2433.660000	2114.571380	-5.077419	0.0	0.0

TOTAL LENGTH =	125.663600	ARC LENGTH =	125.663600		
ERROR(X) =	0.186587D-07	ERROR(Y) =	0.0	ERROR(Z) =	0.712356D-08
ERROR(THETA) =	-0.820405D-09	ERROR(PHI) =	0.0	ERROR(PSI) =	0.0

Table 1. (cont.)

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SURVEY - MADTOT                                    "MAD" VERSION: 4.13        RUN: 17/12/85  13.31.49
SURVEY OF BEAM LINE "TELINE"                                                               PAGE 1
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POS. NO.	ELEMENT NAME	OCC. NO.	SEQUENCE SUM(L) [M]	ARC [M]	POSITIONS X [M]	Y [M]	Z [M]	ANGLES THETA [RAD]	PHI [RAD]	PSI [RAD]
BEGIN	TELINE	1	0.0	0.0	2102.343440	2433.660000	2114.515360	1.441386	0.0	0.0
1	TEDRI001	1	0.680000	0.680000	2103.017754	2433.660000	2114.603114	1.441386	0.0	0.0
2	TEVVS00U	1	0.750000	0.750000	2103.087169	2433.660000	2114.612147	1.441386	0.0	0.0
3	TEVVS00D	1	0.820000	0.820000	2103.156583	2433.660000	2114.621181	1.441386	0.0	0.0
4	TEDRI002	1	1.559000	1.559000	2103.889404	2433.660000	2114.716548	1.441386	0.0	0.0
5	TEUMA00U	1	1.627000	1.627000	2103.956835	2433.660000	2114.725323	1.441386	0.0	0.0
6	TEUMA00D	1	1.689000	1.689000	2104.018317	2433.660000	2114.733324	1.441386	0.0	0.0
7	TEDRI003	1	2.016700	2.016700	2104.343277	2433.660000	2114.775614	1.441386	0.0	0.0
8	TEBHZ10	1	2.576700	2.576700	2104.899129	2433.660000	2114.743850	1.814371	0.0	0.0
9	TEDRI101	1	3.026700	3.026700	2105.335846	2433.660000	2114.635322	1.814371	0.0	0.0
10	TEQFS11U	1	3.294700	3.294700	2105.595936	2433.660000	2114.570688	1.814371	0.0	0.0
11	TEQFS11D	1	3.562700	3.562700	2105.856025	2433.660000	2114.506053	1.814371	0.0	0.0
12	TEDRI111	1	5.806700	5.806700	2108.033786	2433.660000	2113.964860	1.814371	0.0	0.0
13	TEBHZ20	1	6.366700	6.366700	2108.539846	2433.660000	2113.732730	2.187356	0.0	0.0
14	TEDRI201	1	7.417600	7.417600	2109.397247	2433.660000	2113.125066	2.187356	0.0	0.0
15	TEQFW21U	1	7.607600	7.607600	2109.552263	2433.660000	2113.015202	2.187356	0.0	0.0
16	TEQFW21D	1	7.797600	7.797600	2109.707278	2433.660000	2112.905338	2.187356	0.0	0.0
17	TEDRI211	1	8.229600	8.229600	2110.059735	2433.660000	2112.655542	2.187356	0.0	0.0
18	TEQDW22U	1	8.419600	8.419600	2110.214751	2433.660000	2112.545678	2.187356	0.0	0.0
19	TEQDW22D	1	8.609600	8.609600	2110.369767	2433.660000	2112.435814	2.187356	0.0	0.0
20	TEDRI221	1	10.043400	10.043400	2111.539565	2433.660000	2111.606745	2.187356	0.0	0.0
21	TESTP22U	1	10.771900	10.771900	2112.133928	2433.660000	2111.185503	2.187356	0.0	0.0
22	TESTP22D	1	11.500400	11.500400	2112.728291	2433.660000	2110.764261	2.187356	0.0	0.0
23	TEDRI222	1	31.218670	31.218670	2128.815887	2433.660000	2099.362532	2.187356	0.0	0.0
24	TESTP30U	1	31.947170	31.947170	2129.410250	2433.660000	2098.941290	2.187356	0.0	0.0
25	TESTP30D	1	32.675670	32.675670	2130.004614	2433.660000	2098.520049	2.187356	0.0	0.0
26	TEDRI301	1	33.111170	33.111170	2130.359926	2433.660000	2098.268229	2.187356	0.0	0.0
27	TEMTV30	1	33.111170	33.111170	2130.359926	2433.660000	2098.268229	2.187356	0.0	0.0
28	TEDRI302	1	33.540660	33.540660	2130.710335	2433.660000	2098.019884	2.187356	0.0	0.0
29	TEBHZ30	1	34.100660	34.100660	2131.189614	2433.660000	2097.731246	2.038356	0.0	0.0
30	TEDRI303	1	34.849740	34.849740	2131.785005	2433.660000	2092.866537	2.038356	0.0	0.0
31	TEQFW31U	1	45.039740	45.039740	2140.954612	2433.660000	2092.800902	2.038356	0.0	0.0
32	TEQFW31D	1	45.229740	45.229740	2141.124219	2433.660000	2092.715267	2.038356	0.0	0.0
33	TEDRI311	1	47.619640	47.619640	2143.257613	2433.660000	2091.638117	2.038356	0.0	0.0
34	TEQDW32U	1	47.809640	47.809640	2143.427221	2433.660000	2091.552483	2.038356	0.0	0.0
35	TEQDW32D	1	47.999640	47.999640	2143.596828	2433.660000	2091.466848	2.038356	0.0	0.0
36	TEDRI321	1	49.727040	49.727040	2145.138828	2433.660000	2090.688293	2.038356	0.0	0.0
37	TEUMA32U	1	49.795040	49.795040	2145.199530	2433.660000	2090.657645	2.038356	0.0	0.0
38	TEUMA32D	1	49.857040	49.857040	2145.254875	2433.660000	2090.629701	2.038356	0.0	0.0
39	TEDRI322	1	50.191040	50.191040	2145.553027	2433.660000	2090.479164	2.038356	0.0	0.0
40	TEBHZ40	1	50.751040	50.751040	2146.008861	2433.660000	2090.157359	2.332679	0.0	0.0
41	TEDRI401	1	51.683500	51.683500	2146.683531	2433.660000	2089.513696	2.332679	0.0	0.0
42	TEDVT40U	1	51.851000	51.851000	2146.804724	2433.660000	2089.398073	2.332679	0.0	0.0
43	TEDVT40D	1	52.018500	52.018500	2146.925916	2433.660000	2089.282450	2.332679	0.0	0.0
44	TEDRI402	1	52.951000	52.951000	2147.600615	2433.660000	2088.638760	2.332679	0.0	0.0
45	TEQFW41U	1	53.141000	53.141000	2147.738087	2433.660000	2088.507606	2.332679	0.0	0.0
46	TEQFW41D	1	53.331000	53.331000	2147.875559	2433.660000	2088.376452	2.332679	0.0	0.0
47	TEDRI411	1	55.631500	55.631500	2149.540058	2433.660000	2086.788451	2.332679	0.0	0.0
48	TEDVT41U	1	55.799000	55.799000	2149.661250	2433.660000	2086.672829	2.332679	0.0	0.0
49	TEDVT41D	1	55.966500	55.966500	2149.782443	2433.660000	2086.557206	2.332679	0.0	0.0

Table 2. Geometry of the e⁻ transfer line

| ELEMENT | | ELEMENT | | SEQUENCE | | POSITIONS | | | | ANGLES | |
POS. NO.	NAME	OCC. NO.		SUM(L) [M]	ARC [M]	X [M]	Y [M]	Z [M]	THETA [RAD]	PHI [RAD]	PSI [RAD]
50	TEDRI412	1		57.362000	57.362000	2150.792140	2433.660000	2085.593913	2.332679	0.0	0.0
51	TEVVS41U	1		57.432000	57.432000	2150.842788	2433.660000	2085.545593	2.332679	0.0	0.0
52	TEVVS41D	1		57.502000	57.502000	2150.893435	2433.660000	2085.497273	2.332679	0.0	0.0
53	TEDRI413	1		59.881000	59.881000	2152.614731	2433.660000	2083.855086	2.332679	0.0	0.0
54	TEUMA41U	1		59.949000	59.949000	2152.663932	2433.660000	2083.808146	2.332679	0.0	0.0
55	TEUMA41D	1		60.011000	60.011000	2152.708791	2433.660000	2083.765349	2.332679	0.0	0.0
56	TEDRI414	1		60.469000	60.469000	2153.040172	2433.660000	2083.449198	2.332679	0.0	0.0
END	TELINE	1		60.469000	60.469000	2153.040172	2433.660000	2083.449198	2.332679	0.0	0.0

TOTAL LENGTH =	60.469000	ARC LENGTH =	60.469000
ERROR(X) =	0.506967D+02	ERROR(Y) =	0.0	ERROR(Z) =	-0.310662D+02
ERROR(THETA) =	0.891293D+00	ERROR(PHI) =	0.0	ERROR(PSI) =	0.0

Table 2. (cont.)

POS. NO.	ELEMENT OCC. NO.	ELEMENT NAME	SUM(L) [M]	ARC [M]	X [M]	Y [M]	Z [M]	THETA [RAD]	PHI [RAD]	PSI [RAD]
BEGIN		TPLINE	0.0	0.0	2102.343440	2433.660000	2114.515360	4.111740	0.0	0.0
1	1	TPDRI001	0.750000	0.750000	2101.724713	2433.660000	2114.091477	4.111740	0.0	0.0
2	1	TPVVS00U	0.820000	0.820000	2101.666965	2433.660000	2114.051914	4.111740	0.0	0.0
3	1	TPVVS00D	0.890000	0.890000	2101.609218	2433.660000	2114.012352	4.111740	0.0	0.0
4	1	TPDRI002	1.560000	1.560000	2101.056488	2433.660000	2113.633682	4.111740	0.0	0.0
5	1	TPUMA00U	1.622000	1.622000	2101.005340	2433.660000	2113.598641	4.111740	0.0	0.0
6	1	TPUMA00D	1.690000	1.690000	2100.949242	2433.660000	2113.560209	4.111740	0.0	0.0
7	1	TPDRI003	2.019140	2.019140	2100.677712	2433.660000	2113.374187	4.111740	0.0	0.0
8	1	TPBHZ10	2.579140	2.579140	2100.188274	2433.660000	2113.103839	4.303726	0.0	0.0
9	1	TPDRI101	9.556040	9.556040	2093.785901	2433.660000	2110.331339	4.303726	0.0	0.0
10	1	TPSTP10U	10.284540	10.284540	2093.117391	2433.660000	2110.041845	4.303726	0.0	0.0
11	1	TPSTP10D	11.013040	11.013040	2092.448880	2433.660000	2109.752352	4.303726	0.0	0.0
12	1	TPDRI102	11.783040	11.783040	2091.742288	2433.660000	2109.446367	4.303726	0.0	0.0
13	1	TPQDW11U	11.973040	11.973040	2091.567934	2433.660000	2109.370865	4.303726	0.0	0.0
14	1	TPQDW11D	12.163040	12.163040	2091.393580	2433.660000	2109.295362	4.303726	0.0	0.0
15	1	TPDRI111	12.780840	12.780840	2090.826654	2433.660000	2109.049859	4.303726	0.0	0.0
16	1	TPQFW12U	12.970840	12.970840	2090.652300	2433.660000	2108.974356	4.303726	0.0	0.0
17	1	TPQFW12D	13.160840	13.160840	2090.477945	2433.660000	2108.898853	4.303726	0.0	0.0
18	1	TPDRI121	37.872130	37.872130	2067.801557	2433.660000	2099.079013	4.303726	0.0	0.0
19	1	TPQDW13U	38.062130	38.062130	2067.627203	2433.660000	2099.003510	4.303726	0.0	0.0
20	1	TPQDW13D	38.252130	38.252130	2067.452849	2433.660000	2098.928007	4.303726	0.0	0.0
21	1	TPDRI131	38.920130	38.920130	2066.839857	2433.660000	2098.662556	4.303726	0.0	0.0
22	1	TPQFW14U	39.110130	39.110130	2066.665503	2433.660000	2098.587053	4.303726	0.0	0.0
23	1	TPQFW14D	39.300130	39.300130	2066.491149	2433.660000	2098.511550	4.303726	0.0	0.0
24	1	TPDRI141	40.046130	40.046130	2065.806580	2433.660000	2098.215103	4.303726	0.0	0.0
25	1	TPSTP14U	40.774630	40.774630	2065.138070	2433.660000	2097.925609	4.303726	0.0	0.0
26	1	TPSTP14D	41.503130	41.503130	2064.469559	2433.660000	2097.636116	4.303726	0.0	0.0
27	1	TPDRI142	52.009450	52.009450	2054.828404	2433.660000	2093.461085	4.303726	0.0	0.0
28	1	TPMTV14	52.009450	52.009450	2054.828404	2433.660000	2093.461085	4.303726	0.0	0.0
29	1	TPDRI143	52.437030	52.437030	2054.436034	2433.660000	2093.291173	4.303726	0.0	0.0
30	1	TPBHZ20	52.997030	52.997030	2053.966245	2433.660000	2092.990798	3.983304	0.0	0.0
31	1	TPDRI201	53.434530	53.434530	2053.639964	2433.660000	2092.699341	3.983304	0.0	0.0
32	1	TPDVT20U	53.602030	53.602030	2053.515046	2433.660000	2092.587755	3.983304	0.0	0.0
33	1	TPDVT20D	53.769530	53.769530	2053.390127	2433.660000	2092.476169	3.983304	0.0	0.0
34	1	TPDRI202	53.924600	53.924600	2053.274478	2433.660000	2092.372863	3.983304	0.0	0.0
35	1	TPUMA20U	53.986600	53.986600	2053.228239	2433.660000	2092.331559	3.983304	0.0	0.0
36	1	TPUMA20D	54.054600	54.054600	2053.177526	2433.660000	2092.286259	3.983304	0.0	0.0
37	1	TPDRI203	56.307700	56.307700	2051.497199	2433.660000	2090.785271	3.983304	0.0	0.0
38	1	TPQFW21U	56.497700	56.497700	2051.355500	2433.660000	2090.658696	3.983304	0.0	0.0
39	1	TPQFW21D	56.687700	56.687700	2051.213801	2433.660000	2090.532120	3.983304	0.0	0.0
40	1	TPDRI211	59.947700	59.947700	2048.782545	2433.660000	2088.360349	3.983304	0.0	0.0
41	1	TPDVT21U	60.115200	60.115200	2048.657626	2433.660000	2088.248763	3.983304	0.0	0.0
42	1	TPDVT21D	60.282700	60.282700	2048.532707	2433.660000	2088.137176	3.983304	0.0	0.0
43	1	TPDRI212	61.805300	61.805300	2047.397176	2433.660000	2087.122839	3.983304	0.0	0.0
44	1	TPVVS21U	61.875300	61.875300	2047.344971	2433.660000	2087.076206	3.983304	0.0	0.0
45	1	TPVVS21D	61.945300	61.945300	2047.292766	2433.660000	2087.029573	3.983304	0.0	0.0
46	1	TPDRI213	64.320300	64.320300	2045.521528	2433.660000	2085.447377	3.983304	0.0	0.0
47	1	TPUMA21U	64.382300	64.382300	2045.475290	2433.660000	2085.406074	3.983304	0.0	0.0
48	1	TPUMA21D	64.450300	64.450300	2045.424576	2433.660000	2085.360773	3.983304	0.0	0.0
49	1	TPDRI214	64.908300	64.908300	2045.083007	2433.660000	2085.055659	3.983304	0.0	0.0

Table 3. Geometry of the e^+ transfer line

POS. NO.	ELEMENT NAME	OCC. NO.	I I	SEQUENCE SUM(L) [M]	ARC [M]	I I	POSITIONS X [M]	Y [M]	Z [M]	I I	ANGLES THETA [RAD]	PHI [RAD]	PSI [RAD]
END	TPLINE	1		64.908300	64.908300		2045.083007	2433.660000	2085.055659		3.983304	0.0	0.0

```
TOTAL LENGTH =    64.908300        ARC LENGTH =  64.908300
ERROR(X)     = -0.572604D+02       ERROR(Y)   =  0.0          ERROR(Z)   = -0.294597D+02
ERROR(THETA) = -0.128436D+00       ERROR(PHI) =  0.0          ERROR(PSI) =  0.0
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Table 3. (cont.)

POS. NO.	ELEMENT OCC. NO.	ELEMENT NAME	SEQUENCE SUM(L) [M]	ARC [M]	III	POSITIONS X [M]	POSITIONS Y [M]	POSITIONS Z [M]	III	ANGLES THETA [RAD]	ANGLES PHI [RAD]	ANGLES PSI [RAD]
BEGIN		IPLIN	0.0	0.0		2089.820080	2433.510000	2147.285510		2.776562	0.0	0.0
1	1	IPDRI001	0.797420	0.797420		2090.104741	2433.510000	2146.540630		2.776562	0.0	0.0
2	1	IPBSH00	1.357420	1.357420		2090.344828	2433.510000	2146.035344		2.619482	0.0	0.0
3	1	IPDRI002	2.207140	2.207140		2090.768592	2433.510000	2145.298833		2.619482	0.0	0.0
4	1	IPWCM00U	2.307140	2.307140		2090.793528	2433.510000	2145.255494		2.619482	0.0	0.0
5	1	IPWCM00D	2.358840	2.358840		2090.818463	2433.510000	2145.212156		2.619482	0.0	0.0
6	1	IPDRI003	2.358840	2.358840		2090.844246	2433.510000	2145.167344		2.619482	0.0	0.0
7	1	IPBVT00	2.693840	2.693840		2091.011312	2433.511630	2144.876981		2.619482	0.009734	0.000000
8	1	IPDRI004	3.626940	3.626940		2091.476636	2433.520713	2144.068238		2.619482	0.009734	0.000000
9	1	IPMTV00	3.626940	3.626940		2091.476636	2433.520713	2144.068238		2.619482	0.009734	0.000000
10	1	IPDRI005	3.836940	3.836940		2091.581361	2433.522757	2143.886225		2.619482	0.009734	0.000000
11	1	IPVVS00U	3.906940	3.906940		2091.616269	2433.523439	2143.825554		2.619482	0.009734	0.000000
12	1	IPVVS00D	3.976940	3.976940		2091.651177	2433.524120	2143.764883		2.619482	0.009734	0.000000
13	1	IPDRI006	4.194050	4.194050		2091.759447	2433.526233	2143.576708		2.619482	0.009734	0.003433
14	1	IPBHZ10	4.754050	4.754050		2092.116930	2433.531740	2143.149385		2.270417	0.009734	0.003433
15	1	IPDRI101	5.388060	5.388060		2092.601979	2433.537911	2142.741148		2.270417	0.009734	0.003433
16	1	IPQFW11U	5.578060	5.578060		2092.747339	2433.539761	2142.618808		2.270417	0.009734	0.003433
17	1	IPQFW11D	5.768060	5.768060		2092.892698	2433.541610	2142.496467		2.270417	0.009734	0.003433
18	1	IPDRI111	6.444070	6.444070		2093.409880	2433.548190	2142.061186		2.270417	0.009734	0.003433
19	1	IPBHZ20	7.004070	7.004070		2093.891957	2433.553697	2141.781901		1.921352	0.009734	0.006865
20	1	IPDRI201	7.486180	7.486180		2094.344724	2433.558390	2141.616342		1.921352	0.009734	0.006865
21	1	IPMSH20	7.486180	7.486180		2094.344724	2433.558390	2141.616342		1.921352	0.009734	0.006865
22	1	IPDRI202	7.506180	7.506180		2094.363507	2433.558584	2141.609474		1.921352	0.009734	0.006865
23	1	IPSLH20U	7.606180	7.606180		2094.457421	2433.559558	2141.575134		1.921352	0.009734	0.006865
24	1	IPSLH20D	7.706180	7.706180		2094.551335	2433.560531	2141.540793		1.921352	0.009734	0.006865
25	1	IPDRI203	8.113680	8.113680		2094.934033	2433.564497	2141.400857		1.921352	0.009734	0.006865
26	1	IPQDW21U	8.303680	8.303680		2095.112469	2433.566347	2141.335610		1.921352	0.009734	0.006865
27	1	IPQDW21D	8.493680	8.493680		2095.290905	2433.568196	2141.270363		1.921352	0.009734	0.006865
28	1	IPDRI211	9.055680	9.055680		2095.818701	2433.573666	2141.077370		1.921352	0.009734	0.006865
29	1	IPQFW22U	9.245680	9.245680		2095.997137	2433.575516	2141.012124		1.921352	0.009734	0.006865
30	1	IPQFW22D	9.435680	9.435680		2096.175573	2433.577365	2140.946877		1.921352	0.009734	0.006865
31	1	IPDRI221	9.761180	9.761180		2096.481262	2433.580533	2140.835099		1.921352	0.009734	0.006865
32	1	IPMTV22	9.761180	9.761180		2096.481262	2433.580533	2140.835099		1.921352	0.009734	0.006865
33	1	IPDRI222	10.788280	10.788280		2097.445850	2433.590530	2140.482389		1.921352	0.009734	0.006865
34	1	IPQDW23U	10.978280	10.978280		2097.624286	2433.592380	2140.417143		1.921352	0.009734	0.006865
35	1	IPQDW23D	11.168280	11.168280		2097.802722	2433.594229	2140.351896		1.921352	0.009734	0.006865
36	1	IPDRI231	11.589080	11.589080		2098.197912	2433.598325	2140.207392		1.921352	0.009734	0.006865
37	1	IPQFW24U	11.779080	11.779080		2098.376348	2433.600174	2140.142145		1.921352	0.009734	0.006865
38	1	IPQFW24D	11.969080	11.969080		2098.554784	2433.602024	2140.076898		1.921352	0.009734	0.006865
39	1	IPDRI241	13.596680	13.596680		2100.083324	2433.617866	2139.517974		1.921352	0.009734	0.006865
40	1	IPQDW25U	13.786680	13.786680		2100.261760	2433.619715	2139.452728		1.921352	0.009734	0.006865
41	1	IPQDW25D	13.976680	13.976680		2100.440196	2433.621564	2139.387481		1.921352	0.009734	0.006865
42	1	IPDRI251	14.682880	14.682880		2101.103415	2433.628438	2139.144969		1.921352	0.009734	0.006865
43	1	IPDHZ25U	14.850380	14.850380		2101.260721	2433.630069	2139.087449		1.921352	0.009734	0.006865
44	1	IPDHZ25D	15.017880	15.017880		2101.418026	2433.631699	2139.029929		1.921352	0.009734	0.006865
45	1	IPDRI252	15.260380	15.260380		2101.645767	2433.634059	2138.946654		1.921352	0.009734	0.006865
46	1	IPQFW26U	15.450380	15.450380		2101.824203	2433.635909	2138.881407		1.921352	0.009734	0.006865
47	1	IPQFW26D	15.640380	15.640380		2102.002639	2433.637758	2138.816161		1.921352	0.009734	0.006865
48	1	IPDRI261	15.990390	15.990390		2102.331347	2433.641165	2138.695966		1.921352	0.009734	0.006865
49	1	IPBHZ30	16.550390	16.550390		2102.813424	2433.646672	2138.416680		2.270417	0.009734	0.003433

Table 4. Geometry of the e+ ejection line (MAD)

POS. NO.	ELEMENT NAME	ELEMENT OCC. NO.	SEQUENCE SUM(L) [M]	ARC [M]	I I I	POSITIONS X [M]	Y [M]	Z [M]	I I I	ANGLES THETA [RAD]	PHI [RAD]	PSI [RAD]
50	IPDRI301	1	17.750611	17.750611		2103.731653	2433.658354	2137.643861		2.270417	0.009734	0.003433
51	IPBVT30	1	18.085611	18.085611		2103.987949	2433.659985	2137.428145		2.270451	-0.000000	0.003432
52	IPDRI302	1	18.229111	18.229111		2104.097736	2433.659985	2137.335737		2.270451	-0.000000	0.003432
53	IPMTV30	1	18.229111	18.229111		2104.097736	2433.659985	2137.335737		2.270451	-0.000000	0.003432
54	IPDRI303	1	18.791088	18.791088		2104.527685	2433.659985	2136.973850		2.270451	-0.000000	0.003432
55	IPSMH31	1	19.041088	19.041088		2104.684199	2433.659984	2136.780831		2.650060	-0.000000	0.003433
56	IPDRI311	1	19.494438	19.494438		2104.898170	2433.659984	2136.381153		2.650060	-0.000000	0.003433
57	IPSMH32	1	19.744438	19.744438		2105.001924	2433.659984	2136.153883		2.776596	-0.000000	0.003433
58	IPDRI321	1	20.219268	20.219268		2105.171413	2433.659984	2135.710333		2.776596	-0.000000	0.003433
END	IPLIN	1	20.219268	20.219268		2105.171413	2433.659984	2135.710333		2.776596	-0.000000	0.003433

TOTAL LENGTH = 20.219268   ARC LENGTH = 20.219268
ERROR(X) = 0.153513D+02   ERROR(Y) = 0.149984D+00   ERROR(Z) = -0.115752D+02
ERROR(THETA) = 0.341566D-04   ERROR(PHI) = -0.299115D-06   ERROR(PSI) = 0.343258D-02

Table 4. (cont.)

***** IPEPA *****

) NO DATE

	X-COORDINATE	Y-COORDINATE	Z-COORDINATE	GISEMENT	HOR ANGLE	VERT ANGLE
REQUIRED INITIAL	2147.28551	2089.82008	2433.51000	323.23857	2.776562	0.000000
FINAL	2135.73431	2105.23412	2433.66000	0.00000	7.853982	0.000000

FH = 1.0000000   FV = 1.0000000

I	ELEMENT	K	L (M)	DEFL ANGLE (RAD)	TILT (DEG)	X (M)	Y (M)	Z (M)	HOR ANGLE (M)	VERT ANGL (RAD)
1	IPDRI001	1	.797	-.157080	0.00	2146.54063	2090.10474	2433.510	2.776562	0.000000
2	IPBSH002	1	.559			2146.23585	2090.34483	2433.510	2.619482	0.000000
3	IPDRI002	1	.850			2145.92884	2090.76459	2433.510	2.619482	0.000000
4	IPMC4003	1	.100			2145.21216	2090.81846	2433.510	2.619482	0.000000
5	IPDRI003	5	.052			2145.16735	2090.84424	2433.510	2.619482	-.009734
6	IPDVI004	1	.335	.009734	0.00	2144.87698	2091.01131	2433.512	2.619482	-.009734
7	IPCRI004	1	.300			2144.06824	2091.47664	2433.521	2.619482	-.009734
8	IPMTV005	1	0.000			2144.06823	2091.47664	2433.521	2.619482	-.009734
9	IPDRI005	1	.210			2143.88623	2091.58118	2433.524	2.619482	-.009734
10	IPVVS006	1	.140			2143.76487	2091.65118	2433.526	2.619482	-.009734
11	IPDRI006	1	.217	-.349048		2143.57671	2091.75945	2433.528	2.619482	-.009734
12	IPBHZ10	8	.557			2143.14939	2092.11693	2433.532	2.270417	-.009734
13	IPDRI101	1	.634			2142.74115	2092.60199	2433.538	2.270417	-.009734
14	IPCFWI11	1	.380			2142.49647	2092.89270	2433.542	2.270417	-.009734
15	IPDRI11	8	.676	-.349048		2142.06119	2093.40988	2433.548	2.270417	-.009734
16	IPDRI201	1	.557		.10	2141.61635	2093.89795	2433.558	1.921352	-.009734
17	IPBHZ20	1	.482			2141.26191	2094.34472	2433.558	1.921352	-.009734
18	IPMSH20	1	0.000			2141.26191	2094.34472	2433.558	1.921352	-.009734
19	IPDRI202	1	.208			2141.00948	2094.36511	2433.559	1.921352	-.009734
20	IPSLH202	1	.208			2141.54080	2094.55133	2433.561	1.921352	-.009734
21	IPDRI203	1	.382			2141.07038	2094.93000	2433.564	1.921352	-.009734
22	IPJDK211	1	.560			2141.27037	2095.29000	2433.568	1.921352	-.009734
23	IPDRI211	1	.380			2140.94688	2095.81870	2433.571	1.921352	-.009734
24	IPGFWI22	1	.326			2140.83511	2096.17557	2433.577	1.921352	-.009734
25	IPMTV221	1	0.000			2140.83511	2096.48126	2433.581	1.921352	-.009734
26	IPDRI221	1	1.027			2140.48240	2096.48126	2433.581	1.921352	-.009734
27	IPDRI222	1	.380			2140.35190	2097.80272	2433.591	1.921352	-.009734
28	IPDRI231	1	.421			2140.20740	2097.92791	2433.594	1.921352	-.009734
29	IPDRI24	1	1.628			2140.07691	2098.19791	2433.598	1.921352	-.009734
30	IPDR124I	1	.380			2139.51798	2098.55478	2433.608	1.921352	-.009734
31	IPUDW25	1	.380			2139.38749	2099.08332	2433.618	1.921352	-.009734
32	IPDRI251	1	.706			2139.14498	2100.44020	2433.622	1.921352	-.009734
33	IPDHZ25	1	.345			2139.02994	2101.41807	2433.628	1.921352	-.009734
34	IPDRI252	1	.380			2138.04666	2101.64577	2433.632	1.921352	-.009734
35	IPDRI261	1	.380			2138.81617	2102.00264	2433.634	1.921352	-.009734
36	IPDFW26	1	.557			2138.69598	2102.35135	2433.638	1.921352	-.009734
37	IPBHZ30	8	.557	.349048	-.10	2138.41669	2102.81342	2433.641	2.270417	-.009734
38	IPDRI301	5	1.200	-.009734	0.00	2137.64387	2103.42816	2433.647	2.270417	-.009734
39	IPBVI302	1	.335			2137.42816	2103.98795	2433.658	2.270417	0.000000
40	IPMTV302	1	.144			2137.35576	2104.09774	2433.660	2.270417	0.000000
41	IPDRI303	1	0.000			2137.35576	2104.09774	2433.660	2.270417	0.000000
42	IPDRI303	1	.562	.379609	0.00	2136.97388	2104.52770	2433.660	2.270417	0.000000
43	IPSMH31	4	.249			2136.78085	2104.38085	2433.660	2.650026	0.000000
44	IPDRI311	4	.453	.126536	0.00	2136.38118	2104.89322	2433.660	2.650026	0.000000
45	IPSWH32	4	.250			2136.15392	2105.00198	2433.660	2.774562	0.000000
46	IPDRI321	1	.475			2135.71038	2105.17148	2433.660	2.776562	0.000000

DISTANCE IN X-Y PLANE TO REQUESTED POINT= .0671
END-OF-FILE ENCOUNTERED, FILENAME - INPUT
ERROR NUMBER 65 DETECTED BY INPC= AT ADDRESS 000151
CALLED FROM GEOM   AT LINE 13
CALLED FROM BTCH   AT LINE 23

Table 5. Geometry of the e+ ejection line (NEWBEATCH)