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**IMPLICATIONS OF THE DISPLACEMENT
OF THE T1 PRIMARY TARGET IN THE
WEST AREA AT THE CERN SPS**

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Abstract:

As soon as the transfer line TI2 for proton injection into the LHC must be installed, the T1 primary target has to be at least partly dismantled, as its shielding would block the passage of the beam. Even though the installation of TI2 is only foreseen for later, in view of sharing of workload related to the SLI project, it is preferred to move the primary production target T1 for the West Area to its new position already in the shutdown 1999/2000. The new position of the target requires major modifications of support structures in TCC6, of the transfer line towards T1 and of a more than 500 metres long section of the H3 secondary beam in the West Area, all to be completed in the 1999/2000 shutdown. To allow the work to be finished in time, part of it (including some civil engineering in TT4) is already done in the 1998/1999 shutdown. In this memo the necessary modifications are described, cost estimates are given and a planning is provided.

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* This note summarises many fruitful discussions with many people, including O.Bohner, M.Clément, P.Collier, Y.Donjoux, J.C.Gaborit, R.Genand, D.Génolin, P.Grafström, H.D.Graskamp, G.Grobon, A.Hilaire, M.Jonker, K.D.Lohmann, V.Mertens, R.Mollay, A.Monsted, J.Montes, S.Péraire, P.Pierre, J.Ramillon, M.Ross, M.Silari, A.Spinks, G.R.Stevenson, H.Wahl, E.Weisse.

Introduction

In a few years from now, the TI2 transfer line for proton injection from the SPS into the LHC has to be installed. Before that time, starting at the end of the year 2000, civil engineering work for the TI2 tunnel has to start, in particular the connection with the TCC6 primary target zone in the West Area. The trajectory of the TI2 transfer line would traverse the shielding of the T1 primary target itself. Therefore this target has to be moved out of the way. Both the transfer line towards the T1 target, as well as the H3 beam that serves the West Area test beams with secondary particles produced in T1, have to be adapted to the new position. In this note we outline the work that has to be done, its implications, as well as cost estimates and a planning.

1. The target displacement

The T1 target has to be moved downstream by approximately 12 metres and sideways by about 1.5 metres as indicated in figure 1. Its exact co-ordinates are listed in the appended Beatch outputs. At the end of the 1997/1998 shutdown (18-02-98), the induced radioactivity levels around T1 were measured by TIS/RP and levels up to 90 mSv/h were found at the exit of T1, in between the shielding and the pair of MTR dipole magnets following the target. In view of this it was decided to leave the target shielding in place for cool-down till the installation of the TI2 line, to order new shielding and to reuse only the 'active' elements (target box, monitors) of the target. The target box will be reused without changes, while for the instrumentation (TBIU/TBID) one considers the possible replacement of the Aluminium foils by Titanium ones.

After a few more years of cool-down, only the part of the shielding that blocks the passage of the TI2 line will be removed and some local shielding plates or concrete blocks will be installed to protect the surroundings against radiation from the inside of the shielding.

Note that a quadrupole of the transfer line to the new T1 target passes just next to the target shielding. It has been verified that the quadrupole just fits with about 10 cm margin.

As a first step of the work in 1999/2000, a 80 cm thick concrete shielding wall will be erected at the downstream end of T1, before any other work in TCC6 starts, to reduce radiation doses for the personnel working in the area. The new target shielding has been ordered at a cost of 154 kCHF. Delivery has been promised November 1999. A test mounting will be done in the lab. Final mounting in TCC6 should therefore take place in the second half of January 2000. The zone around the new T1 location will be cleaned out and prepared in the first half of January.

The tubing of the T1 cooling system and the transfer line has to be modified. The cost of these modifications have only been estimated very roughly and a more precise estimate will come later.

The jib-crane ('potence'), which serves to install and take out the target box and instrumentation, can be installed on the upstream side of the new T1 target as to minimise interference with the cable tray and other infrastructure above the target. The height of the cable tray has then to be increased locally by some 5 cm and some bus bars and neon tubes have to be slightly displaced. As an alternative solution, the SL-BT group will study the construction of a new tooling, more convenient, safer to operate (reduced radiation exposure and risk of electrical shock and mechanical hazards for the personnel) and adapted to the new environment. The cost of new tooling remains to be estimated.

The dismantling of the old target (in ≈ 2004) and the installation of the new target is supervised by specialists in SL/BT (S.Péraire). The dismantling of the old target will require the use of the shielded Clarks of the Transport group.

Note that the old T1 shielding is on the straight path of the transfer line in case of failure of the bends. It can therefore serve as part of the shielding system for such cases without constructing additional dumps, at least until the target shielding is partly removed and TI2 is installed.

2. The new transfer line

The new transfer line has been designed by A.Hilaire. It contains no more wobbling magnets, as there is no space available for them, due to the interference with magnets in the line towards T9, which will not be dismantled in time¹. The loss of the wobbling station is not a real problem, as the H1 beam (towards the Omega spectrometer) has been dismantled in 1997 and therefore only a single secondary beam line is served from the T1 target. One single restriction in the operation of the H3 beam is introduced by the absence of wobbling: it will no longer be possible to run pure electron beams by converting photons from decay of π^0 's produced in the target. This option, only interesting up to about 150 GeV/c (at higher momenta, one can separate the electrons in the secondary beam from the hadrons by synchrotron radiation), has in reality never been used. Tertiary electron beams produced from a -120 GeV/c direct secondary beam through Bremsstrahlung in a thin Lead target are in fact very pure and give adequate fluxes for test beams. The suppression of the wobbling station eases of course the operation (no more WOBSU surveillance programme required).

The installation of the transfer line will be launched by SL/BT and is discussed with SL/MR and the equipment groups involved. The magnets are available. Some are powered in alternation with magnets in the TI2 line by means of a high-power switch. In case the cabling for the T9 line can not be used, the cabling for the switch (after the shutdown of Lep) will cost approximately 20 kCHF.

3. The two MTR magnets and dumps downstream of the target

At present two MTR magnets, some 13 metres of helium tank and two TAX-type mobile dumps immediately follow the target. Above the target and the beam line there are many cables, that need to be protected from radiation. Hence a massive side and top shielding. To allow rapid intervention in case of breakdowns, in a zone without cranes and with very restricted space, special mechanisms were installed to temporarily remove parts of the shielding in a fast and semi-automatic way. Unfortunately these mechanisms will no longer be compatible with the new layout due to lack of lateral space. Therefore a new system has been designed by Michel Clément, which will fit in the new location. A schematic view of this system is shown in Figure 2. A test mounting is planned to happen in November 1999 in building182, as agreed with EP Division.

Only the vacuum tube and one small quadrupole (about 500 kg) of the TI2 line will interfere in case of (hopefully rare) breakdowns of one of the MTR magnets. In such cases the TI2 quadrupole and the vacuum tube will have to be removed temporarily during the intervention.

¹ At the Chamonix workshop in January 1999 it was announced that the neutrino beam from T9 would no longer be requested. As long as this is not officially confirmed, we assume that elements of the line can be dismantled temporarily, but nothing should be done which interferes with future re-use of the neutrino beam.

Secondly, the TAX will be replaced by fixed dumps of TCX type, not motorised, with a single hole of diameter 64 mm centred on the beam axis.

The choice of TCX is now justified, as

- The H3 will never be operated as a primary beam (its top momentum is 250 GeV/c, i.e. well below the momentum at which the SPS is operated), hence a single large hole is sufficient.
- The protons that traversed the target are dumped cleanly in the TCX, anyway.
- The absence of movement makes the mechanics much simpler and more robust, thus reducing the risk of exposure of personnel to high radiation levels (cf. recent incident on H4 TAX).
- One would have to buy new TAX blocks anyway (position of holes w.r.t. blocks is different), which are much more expensive than TCX blocks (where some are available already).

The thickness of the TCX along the beam can be the same as for two TAX modules (3.2 metres). The problem of muon fluxes through the dump can be avoided by requiring the T1 target head to be in position OUT (as part of the interlock conditions for access to TT61). Note that for primary beam momenta below 400 GeV/c, the maximum strength of the MTRs is such that an external bend limitation would be required to avoid the risk of primary particles traversing the hole in the dump.² In between the MTR and the TCX a 600 mm diameter vacuum tube will be installed. Inside the MTR magnets there will be no vacuum.

The changes in this region are under SL/EA responsibility.

4. The modifications to the H3 secondary beam

The secondary beam leaving the T1 target station towards the West Area leads to a splitter station located some 600 metres downstream of the primary target. From there two branches transport the secondary particles to two secondary targets from which the X5 and X7 beams are produced. These beams, which serve a vigorous test programme of the LHC collaborations and many smaller groups, have recently been upgraded to a top beam momentum of 250 GeV/c. We propose to modify the H3 beam in such a way that it joins up with the existing splitters, while preserving its main characteristics in terms of transmission and optical properties.

The approach is to displace most of the beam sideways in the tunnel by roughly 1.38 metres. Due to the change of height in the transfer line, the beam height of the H3 in the tunnel will increase by about 15 millimetres. The 30 metres long matching section in between the horizontal bend following the TCX and the first vertical bend, so far consisting of 5 quadrupoles, will be shortened by 12 metres. As the top momentum of the H3 beam is now only 250 GeV/c, compared to 400 GeV/c in the past, this can be achieved with 3 quadrupoles only and without significantly changing the beam characteristics at the exit of this section.

At the top of the tunnel, there are now two groups of (essentially vertical) 5 MBE-type dipoles each. To connect the beam to the existing X5/X7 splitters, the outer 4 MBE's of each group will be tilted and the central ones replaced by 2 horizontal MCB magnets each. This requires two additional power supplies for the MCB's, one for each group of two. Those power supplies are available. However, due to the tilt angle the required current in the MBE magnets increases to 4 kAmps, thus requiring a reinforcement of their power cables. Those extra cables have been installed already in 1998. No changes are required downstream of the splitter.

² A similar problem may also occur in other beam lines, where the present limit is adapted to 400 GeV/c.

Please find added in Appendix A the Beatch description of the new beam line. In figure 3 we show the different modifications to the H3 beam schematically. This part of the project is under SL/EA responsibility.

Along the second group of MBE magnets, there is a concrete wall, that separates the tunnel TT61 from the splitter zone TT4 (the old West Area target zone). In fact this wall has a function in supporting the roof, which carries 4 metres of earth on top of it. The wall has to be removed over a length of 6 metres to make space for one of the MBE magnets. Adequate supports are added to reinforce the surrounding structures. Over an additional length of 8 metres, a 35 cm diameter hole has to be traverse the wall at a skew angle to allow the passage of a vacuum tube. ST Division has prepared this and work has been advanced to the 1998/1999 shutdown in order to avoid interference with the activities in TT61 and TCC6 the year after. This work was completed on 12 February 1999.

In the tunnel, TT61, the beam is moved from the South to the North side of the tunnel. Although it eases somewhat the access to TCC6 via the tunnel, all services are now available on the wrong side of the tunnel.

For the cooling water, we try to recuperate as much of the existing material as possible. In the primary target area and in the first 110 metres long section of the H3 beam, the water tube (supplied with water from BA6) will be moved from the South to the North side. In the last 200 metres long section of the tunnel, before the entrance to TT4, the old tubing (from before the H1+H3 upgrade to 400 GeV/c) is still available on the North side of the tunnel. A total of 2x7 valves will be mounted in the inlet pipe to allow cooling of the magnets in this part of the beam. For the intermediate section of the H3 beam (positions 120 to 458) the cooling water and will be done from the South side via flexible tubes to be installed over the top of the tunnel. This work is supervised by ST Division (R.Mollay, A.Monsted) for the fixed tubing.

SL/MS takes care of flexible tubes and also of the power cables, which will traverse the tunnel along the roof. This work involves a total of 35x2 man-days plus 5kCHF materials.

5. Other aspects

Access of personnel to TCC6 is most convenient via BA7. There is one lift for personnel (13 persons) and one for materials (capacity 25 tons). At the time of writing the ambient dose at the passage was of up to almost 100 $\mu\text{Sv/hr}$, but this can be reduced to acceptable levels (40 $\mu\text{Sv/hr}$) by temporarily removing 3 magnets in the T9 line: QTLD660500, QTLD660600 and in particular MPLV660604. The door separating TCC6 and TNC (BA7) would have to be opened and the passage into the neutrino cave locked for the duration of the work. For convenient passage of material the shielding at the exit of TCC6 on the T9 line has to be removed temporarily. Instead some shielding will be installed in a location inside TNC. Temporary storage of equipment between dismounting and reinstallation in a new position can be done in the BA7 zone, further downstream in the neutrino cave. For this purpose a surface of 25x2 m² (with handling facilities) is required for 11 magnets and an additional 60 m² surface with >1.6 metres height for the temporary storage of ≥ 650 tons of steel blocks and 20 steel bars.

The section of the line towards T9 in the region between the old T1 position and the exit of TCC6 has to be temporarily removed, in order to make space for manipulation of other equipment in the work area. In fact it was announced that the CHAMONIX workshop that the neutrino beam from T9 will no longer be required and therefore its reinstallation can be postponed.

The access doors in TT61 have to be slightly modified, mainly to change the position for beam passage. The TCC6 ventilation door has to be moved somewhat and the TCC6/TNC door has to be temporarily dismantled. Total cost estimated to be about 30 kCHF.

Some amount of obsolete radioactive material has to be stored for possible future re-use, requiring 40 m² of space for 6 dipoles and 3 quadrupoles plus, at a later stage, 15 m² for the target shielding blocks. In addition some material can be eliminated, namely 16 TAX blocks, 4 TAX tables, 4 chariots, a 12 metres long vacuum tank (90 cm diameter) with support structure, 4 magnet supports and some jacks, which would occupy a total surface of 60 m². This will be discussed with M.Silari (TIS/RP).

The TI2 ventilation and the civil engineering work for TI2 will be done in the 2000/2001 shutdown. For that purpose a few H3 elements will have to be temporarily removed, but this is not in the scope of this note.

6. Cost and planning

The cost of the displacement of T1 and its implications has been estimated. A break-up is listed in Table 1. The new target shielding and the civil engineering in the TT4/TT61 zone have already been paid. The total cost of the project is **1393 kCHF**, excluding new tooling for interventions on the T1 monitors or target box which is under study in SL-BT and which is expected not to exceed **50 kCHF**.

A planning has been prepared jointly by J.Montes in AC/TCP) and M.Clément with P.Pierre (SL/EA). It is appended as **Table 2**. An up-to-date version is available on the WWW.

M.Clément (SL/EA) has kindly agreed to do the technical co-ordination of the activities in TCC6 and the surrounding areas during the shutdown 1999/2000.

Table 1 : Cost estimate – summary

Item	1999 Cost (kCHF)	2000 Cost (kCHF)	Total (kCHF)	Comments
Manpower SL-EA + transfer line: <i>Drawing office 4 man-months</i> <i>Transport 12+5 man-months</i> <i>Survey 4+1 man-months</i> <i>Radio-protection 2 man-months</i> <i>Vacuum 2+1 man-months</i> <i>Mechanics 2 man-months</i>	82	112+56	250	
Civil engineering wall TT61/TT4 (SL-EA)	96		96	Done
Civil engineering rails TCC6 (SL-EA)		20	20	
MTR plug-in equipment (SL-EA)	50		50	
MTR handling device (SL-EA)	50		50	
Mobile crane MTR + rails (SL-EA)	210	20	230	
Special shielding mobile crane MTR (SL-EA)	40		40	
TCX, excl. Copper blocks (SL-EA)	45		45	
Copper blocks for TCX (SL-EA)	60		60	
Vacuum (SL-EA)	20		20	
H3 magnets handling and support (SL-EA)	70		70	
Infrastructure, services (SL-EA)		25	25	
Flexible tubing H3 (SL/MS)	20		20	
Power cabling H3 (SL/MS)	15		15	
Cabling transfer line (ST-MS)		50	50	<i>Rough est.</i>
New T1 shielding (SL-BT)	154		154	Ordered
Other T1 related items, including manpower (SL-BT)		66	66	
Fixed tubing cooling water H3 (ST/CV)	22		22	85 kFF
Cooling transfer line + T1 (ST-CV)		50	50	<i>Rough est.</i>
Instrumentation for transfer line (SL-BI)		30	30	
Modifications to access doors (ST-AA)		30	30	
Total	934	459	1393	
New jib-crane for T1 interventions (SL-BT)		50	50	<i>Rough est.</i>
Total incl. new T1 jib-crane (to be studied)			1443	
High-power mech. switch TI2/TT60 (SL/PO)		20	20	<i>Rough est.</i>
Total incl. TI2/TT60 switch			1463	T1 or TI2?

Numbers in *italic* are rough estimates, numbers in **bold** are real cost.

Table 2: Provisional planning by J.Montes (AC/TCP) with input from P.Pierre and M.Clément (SL/EA)

See the present version of this planning on Web page:

<http://nicewww.cern.ch/~setnom/spsPLAN/pdf/sps-sd99-00-tcc6.pdf>

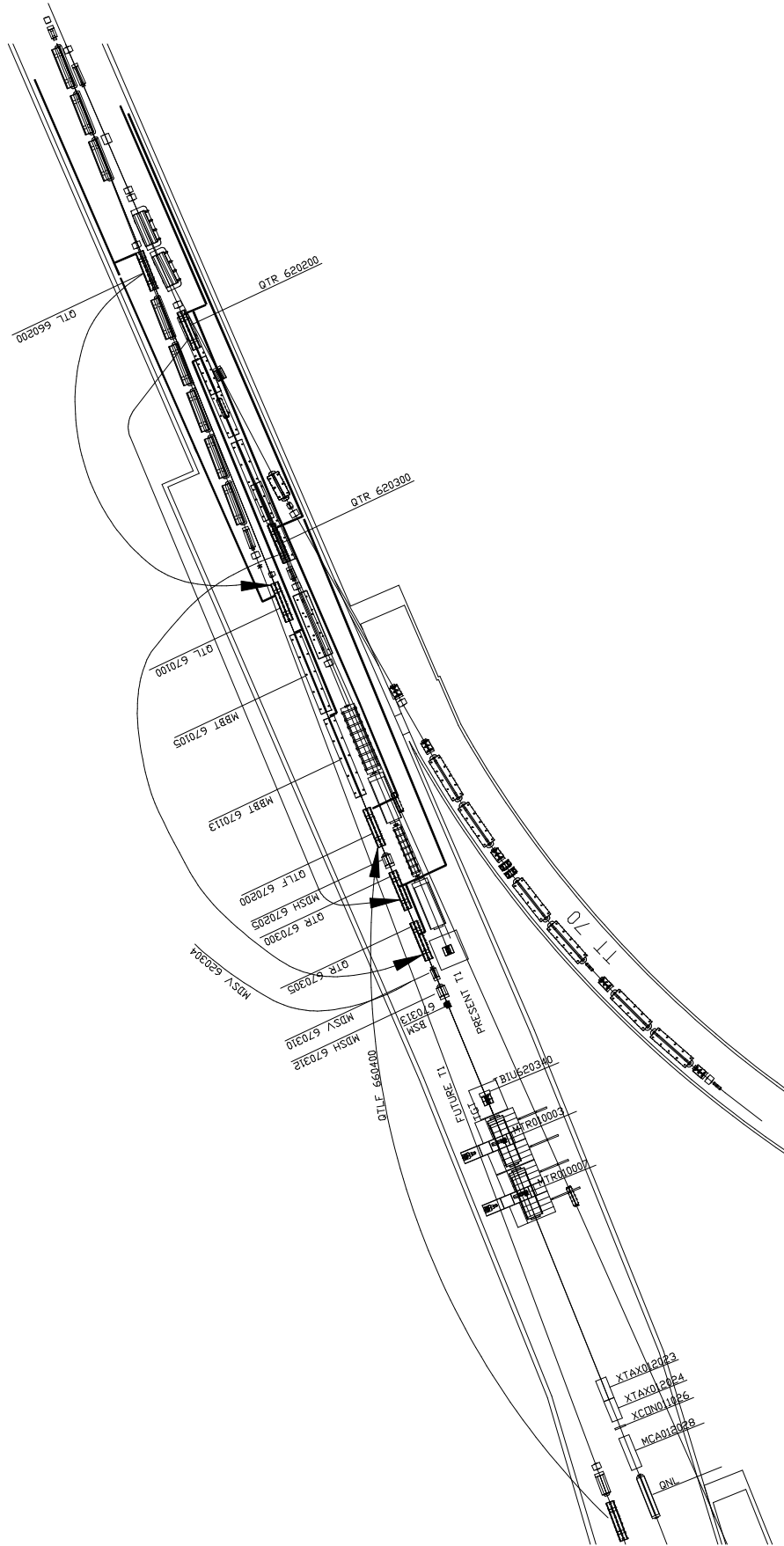


Figure 1: New layout in TCC6

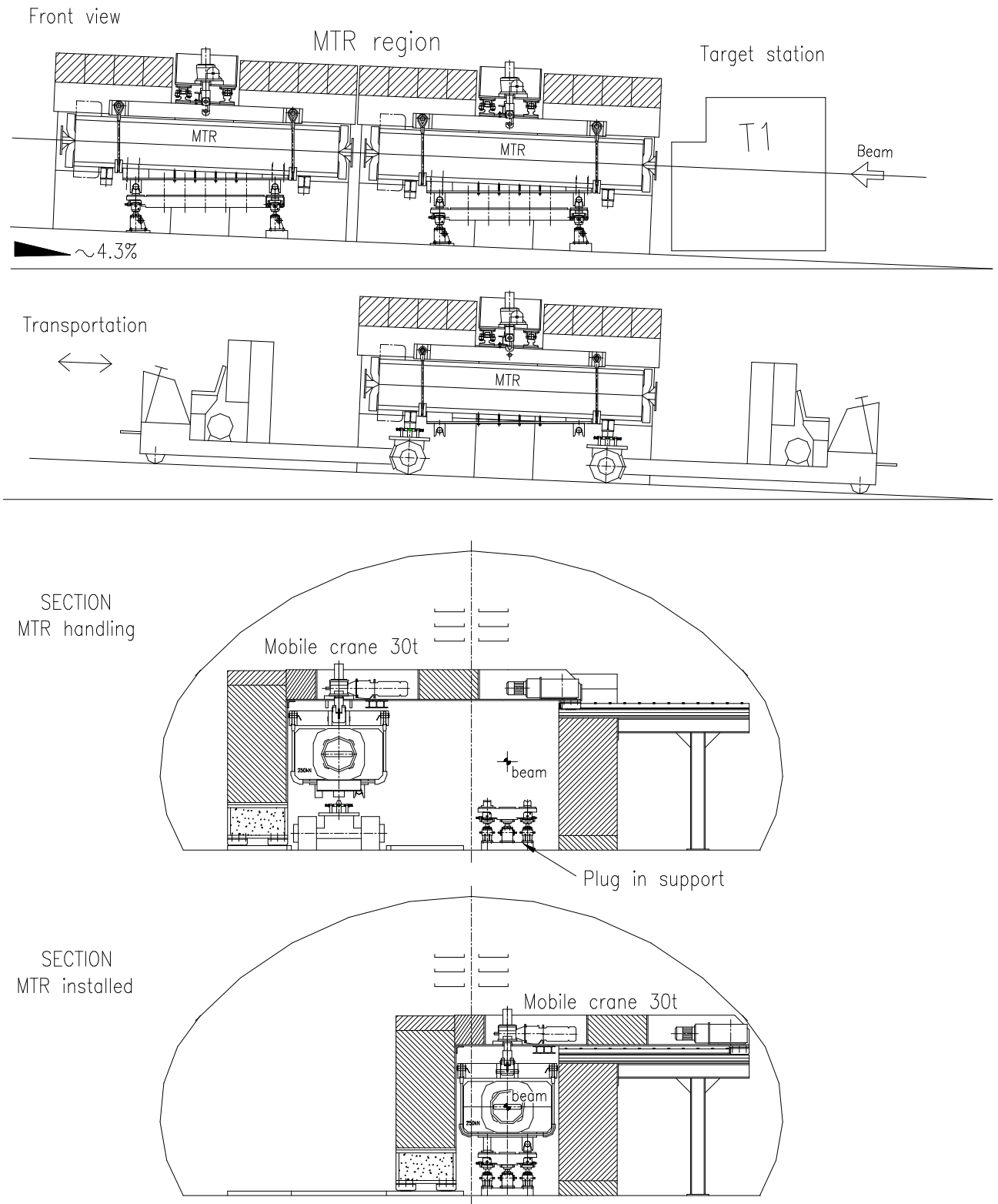


Figure 2: Schematic design of mobile support structures for MTR magnets and shielding in TCC6.

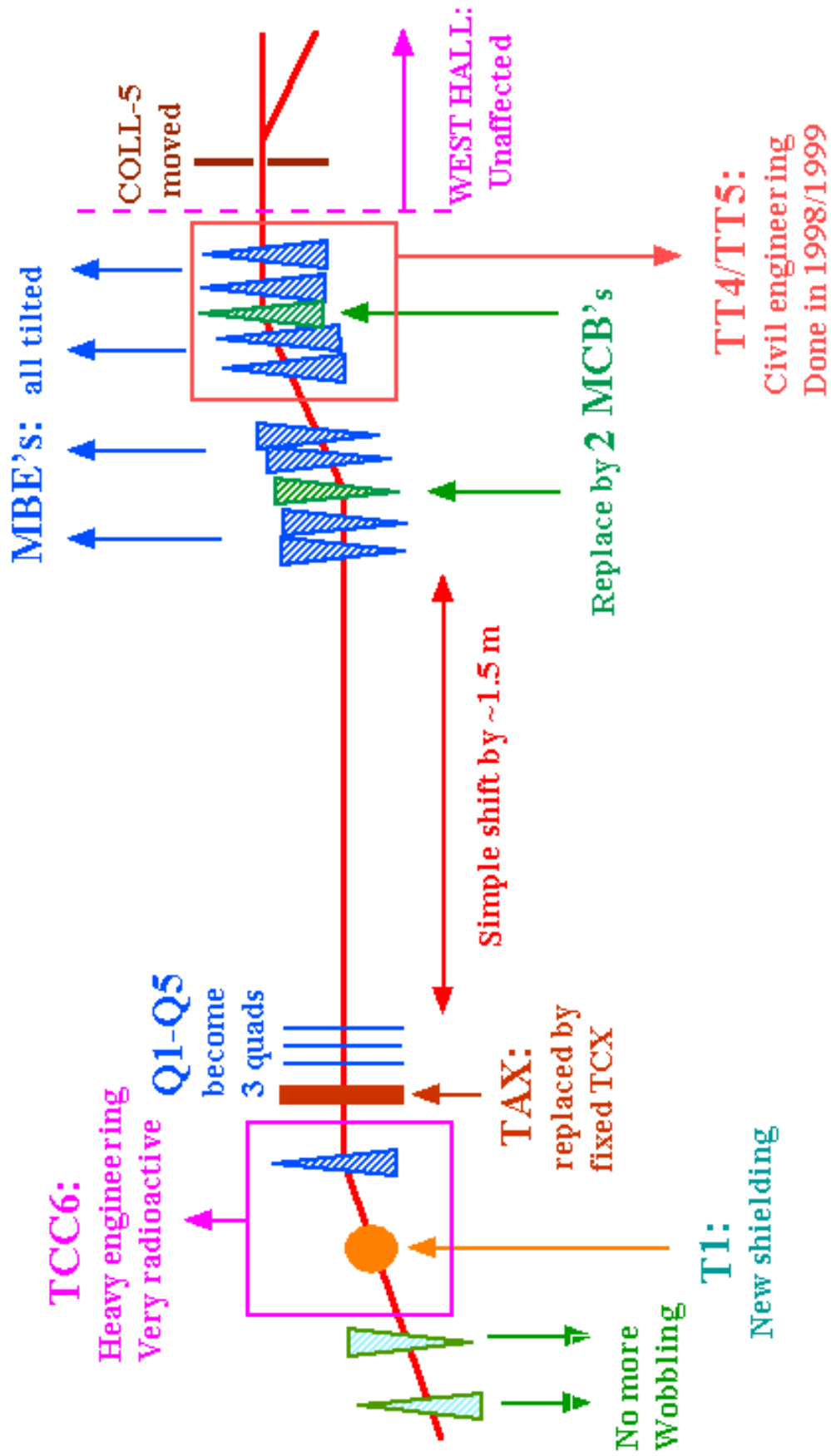


Figure 3: Overview of modifications to the H3 beam

Addendum: Beatch of the new H3 beam

I	ELEMENT	X-COORDINATE	Y-COORDINATE	Z-COORDINATE	GISEMENT	Y	Z	HORIZONTAL ANGLE	VERTICAL ANGLE	BEAM LENGTH
	INITIAL	1806.06813	2462.90082	2408.27607	274.91442			3.535636	.043243	
1			1.000		1805.14563	2462.51725	2408.319	3.535636	.043243	1.000
2	QTL1		3.000		1802.37813	2461.36656	2408.449	3.535636	.043243	4.000
3			2.000		1800.53312	2460.59942	2408.535	3.535636	.043243	6.000
4	QTLB		3.000		1797.76562	2459.44872	2408.665	3.535636	.043243	9.000
5			1.000		1796.84312	2459.06516	2408.708	3.535636	.043243	10.000
6	QTLB		3.000		1794.07562	2457.91446	2408.838	3.535636	.043243	13.000
7			10.480		1784.40780	2453.89469	2409.291	3.535636	.043243	23.480
8	TBIU620340		1.250		1784.17718	2453.79880	2409.302	3.535636	.043243	23.730
9			1.400		1783.80818	2453.64537	2409.319	3.535636	.043243	24.130
10	TGT***	TARGET T1	20.000	.000000	.00	1783.80818	2453.64537	2409.319	3.535636	24.130
11			1.450		1782.47055	2453.08920	2409.382	3.535636	.043243	25.580
12	MTR 010003	B3T, HE	4.3600	-.005600	.00	1779.14569	2451.71767	2409.538	3.530031	29.180
13			1.550		1778.63714	2451.50956	2409.561	3.530031	.043243	29.730
14	MTR 010007	B3T, HE	4.3600	-.005600	.00	1775.30465	2450.15669	2409.717	3.524426	33.330
15			12.850		1763.39600	2445.36107	2410.272	3.524426	.043243	46.180
16	XTCX012023	TCX1	12.1615	.000000	.00	1761.89931	2444.75835	2410.342	3.524426	47.795
17			1.010		1761.89004	2444.75461	2410.343	3.524426	.043243	47.805
18	XTCX012024	TCX2	12.1615	.000000	.00	1760.39335	2444.15190	2410.412	3.524426	49.420
19			1.510		1759.92071	2443.96156	2410.435	3.524426	.043243	49.930
20	XCON011026	CONVERTER	17.100	.000000	.00	1759.82804	2443.92424	2410.439	3.524426	50.030
21	MCA 012028	B1	1.700		1759.17932	2443.66300	2410.469	3.524426	.043243	50.730
22			4.2500	-.001777	.00	1756.86163	2442.73206	2410.577	3.522647	53.230
23			1.720		1756.19390	2442.46455	2410.608	3.522647	.043243	53.950
24	QNL	Q1	2.2990		1753.42096	2441.35361	2410.738	3.522647	.043243	56.940
25			1.5711		1748.12455	2439.23167	2410.984	3.522647	.043243	62.651
26	QNL	Q2	2.2990		1745.35160	2438.12074	2411.114	3.522647	.043243	65.641
27			4.483		1741.19405	2436.45507	2411.307	3.522647	.043243	70.124
28	XCSV012057	C1	10.1150	.000000	.00	1740.12753	2436.02779	2411.357	3.522647	71.274
29			1.135		1740.00233	2435.97763	2411.363	3.522647	.043243	71.409
30	XCSH012058	C2	10.1150	.000000	.00	1738.93581	2435.55034	2411.413	3.522647	72.559

I	ELEMENT	K	L	ANGLE		X	Y	Z	ANGLE		LENGTH
				M	DEG				M	RAD	
31		1	.275			1738.68078	2435.44816	2411.425	3.522647	.043243	72.834
32	QFL Q3	2	1.200			1737.56789	2435.00230	2411.477	3.522647	.043243	74.034
33		1	.426			1737.17282	2434.84402	2411.495	3.522647	.043243	74.460
34	MBE 012065 B2(S3 MODEL INV:)	8	6.200	-.008332	92.71	1731.42444	2432.53970	2411.789	3.523041	.051566	80.660
35		1	1.190			1730.32144	2432.09730	2411.850	3.523041	.051566	81.850
36	MBE 012073 B2(S3 MODEL INV:)	8	6.200	-.008332	92.71	1724.57644	2429.79171	2412.195	3.523435	.059889	88.050
37		1	.440			1724.16886	2429.62804	2412.222	3.523435	.059889	88.490
38	MBE 012079 B2(S3 MODEL INV:)	8	6.200	-.008332	92.71	1718.42764	2427.32134	2412.619	3.523829	.068212	94.690
39		1	.440			1718.02034	2427.15760	2412.649	3.523829	.068212	95.130
40	MBE 012086 B2(S3 MODEL INV:)	8	6.200	-.008332	92.71	1712.28329	2424.84995	2413.097	3.524224	.076535	101.330
41		1	.440			1711.87631	2424.68615	2413.131	3.524224	.076535	101.770
42	MBE 012093 B2(S3 MODEL INV:)	8	6.200	-.008332	92.71	1706.14383	2422.37770	2413.630	3.524618	.084858	107.970
43		1	.650			1705.54310	2422.13565	2413.685	3.524618	.084858	108.620
44	QFS 012097 Q6	2	.800			1704.80374	2421.83775	2413.753	3.524618	.084858	109.420
45		1	.400			1704.43406	2421.68879	2413.787	3.524618	.084858	109.820
46	QFS 012098 Q6	2	.800			1703.69470	2421.39089	2413.855	3.524618	.084858	110.620
47		1	8.425			1695.90831	2418.25355	2414.569	3.524618	.084858	119.045
48	XCSH012107 C3	10	1.150	.000000	.00	1694.84548	2417.82531	2414.666	3.524618	.084858	120.195
49		1	.270			1694.59594	2417.72477	2414.689	3.524618	.084858	120.465
50	MDXH012108 GAP=100. TRIM 1	13	.400	.000000	.00	1694.22626	2417.57581	2414.723	3.524618	.084858	120.865
51		1	28.781			1667.62685	2406.85823	2417.163	3.524618	.084858	149.646
52	QWL 012139 Q7	2	2.948			1664.90231	2405.76044	2417.412	3.524618	.084858	152.594
53		1	26.630			1640.29085	2395.84386	2419.670	3.524618	.084858	179.224
54	QPL 012168 Q8	2	2.000			1638.44245	2395.09909	2419.839	3.524618	.084858	181.224
55		1	1.400			1637.14856	2394.57775	2419.958	3.524618	.084858	182.624
56	QPS 012171 Q8	2	1.000			1636.22436	2394.20537	2420.042	3.524618	.084858	183.624
57		1	10.951			1626.10344	2390.12739	2420.971	3.524618	.084858	194.575
58	XCBV012183 C4	11	1.200	.000000	.00	1624.99440	2389.68053	2421.072	3.524618	.084858	195.775
59		1	10.951			1614.87348	2385.60256	2422.001	3.524618	.084858	206.726
60	QPS 012195 Q8	2	1.000			1613.94928	2385.23017	2422.085	3.524618	.084858	207.726
61		1	1.400			1612.65540	2384.70884	2422.204	3.524618	.084858	209.126
62	QPL 012198 Q8	2	2.000			1610.80700	2383.96407	2422.373	3.524618	.084858	211.126
63		1	19.272			1592.99581	2376.78748	2424.007	3.524618	.084858	230.398
64	XFFV012219 FISC 1 (N)	7	.276	.000000	.00	1592.74073	2376.68471	2424.030	3.524618	.084858	230.674
65		1	6.460			1586.77039	2374.27911	2424.578	3.524618	.084858	237.134
66	XFSH012225 FISC 2	6	.276	.000000	.00	1586.51532	2374.17633	2424.601	3.524618	.084858	237.410
67		1	.346			1586.19554	2374.04748	2424.630	3.524618	.084858	237.756
68	QWL 012227 Q7	2	2.948			1583.47100	2372.94970	2424.880	3.524618	.084858	240.704
69		1	39.026			1547.40315	2358.41704	2428.188	3.524618	.084858	279.730
70	QFS 012268 Q6	2	.800			1546.66379	2358.11913	2428.256	3.524618	.084858	280.530
71		1	.400			1546.29411	2357.97018	2428.290	3.524618	.084858	280.930
72	QFS 012269 Q6	2	.800			1545.55475	2357.67227	2428.358	3.524618	.084858	281.730
73		1	17.042			1529.80452	2351.32611	2429.802	3.524618	.084858	298.772

I	ELEMENT	K	L	ANGLE		X	Y	Z	ANGLE		LENGTH
				M	DEG				M	RAD	
74	** MID TT60 **	1	.000			1529.80452	2351.32611	2429.802	3.524618	.084858	298.772
75	XFSV012286 FISC 3	7	.276	.000000	.00	1529.54944	2351.22333	2429.825	3.524618	.084858	299.048
76		1	.369			1529.20841	2351.08592	2429.857	3.524618	.084858	299.417
77	MDSV012287 TRIM 2 CH: EPP	14	.700	.000000	.00	1528.56147	2350.82525	2429.916	3.524618	.084858	300.117
78		1	15.645			1514.10236	2344.99930	2431.242	3.524618	.084858	315.762
79	XFSH012304 FISC 4	6	.276	.000000	.00	1513.84728	2344.89653	2431.265	3.524618	.084858	316.038
80		1	.735			1513.16799	2344.62282	2431.328	3.524618	.084858	316.773
81	MDXH012305 GAP=100.TRIM 3.INV	13	.400	.000000	.00	1512.79831	2344.47387	2431.362	3.524618	.084858	317.173
82		1	3.237			1509.80667	2343.26846	2431.636	3.524618	.084858	320.410
83	QFS 012309 Q9	2	.800			1509.06731	2342.97056	2431.704	3.524618	.084858	321.210
84		1	.400			1508.69763	2342.82160	2431.738	3.524618	.084858	321.610
85	QFS 012310 Q9	2	.800			1507.95827	2342.52369	2431.805	3.524618	.084858	322.410
86		1	35.545			1475.10756	2329.28731	2434.818	3.524618	.084858	357.955
87		1	.481			1474.66302	2329.10819	2434.859	3.524618	.084858	358.436
88	QWL 012348 Q10	2	2.948			1471.93848	2328.01040	2435.109	3.524618	.084858	361.384
89		1	20.200			1453.26963	2320.48825	2436.821	3.524618	.084858	381.584
90	QPL 012370 Q11. :	2	2.000			1451.42123	2319.74348	2436.990	3.524618	.084858	383.584
91		1	1.600			1449.94251	2319.14767	2437.126	3.524618	.084858	385.184
92	QPS 012373 Q11. :	2	1.000			1449.01831	2318.77528	2437.211	3.524618	.084858	386.184
93		1	7.848			1441.76518	2315.85281	2437.876	3.524618	.084858	394.032
94	XFFV012382 F.FISC 5	7	.276	.000000	.00	1441.51010	2315.75004	2437.899	3.524618	.084858	394.308
95	XFFH012383 F.FISC 6	6	.276	.000000	.00	1441.25502	2315.64726	2437.923	3.524618	.084858	394.584
96		1	.135			1441.13026	2315.59699	2437.934	3.524618	.084858	394.719
97	XWCM012383 MWPC 1,2	9	.320	.000000	.00	1440.83451	2315.47782	2437.961	3.524618	.084858	395.039
98		1	.500			1440.37241	2315.29163	2438.004	3.524618	.084858	395.539
99	MDIV012384 TRIM 4.ISR. VAC: 14	14	.650	.000000	.00	1439.77168	2315.04958	2438.059	3.524618	.084858	396.189
100		1	11.642			1429.01214	2310.71429	2439.045	3.524618	.084858	407.831
101	QPS 012396 Q11	2	1.000			1428.08794	2310.34190	2439.130	3.524618	.084858	408.831
102		1	1.600			1426.60922	2309.74609	2439.266	3.524618	.084858	410.431
103	QPL 012399 Q11	2	2.000			1424.76082	2309.00132	2439.435	3.524618	.084858	412.431
104		1	20.195			1406.09659	2301.48103	2441.147	3.524618	.084858	432.626
105	QWL 012422 Q10	2	2.948			1403.37204	2300.38324	2441.397	3.524618	.084858	435.574
106		1	.406			1402.99682	2300.23205	2441.431	3.524618	.084858	435.980
107		1	33.820			1371.74036	2287.63803	2444.298	3.524618	.084858	469.800
108	QFS 012458 Q9	2	.800			1371.00100	2287.34012	2444.365	3.524618	.084858	470.600
109		1	.400			1370.63132	2287.19117	2444.399	3.524618	.084858	471.000
110	QFS 012459 Q9	2	.800			1369.89196	2286.89326	2444.467	3.524618	.084858	471.800
111		1	3.035			1367.08701	2285.76308	2444.724	3.524618	.084858	474.835
112		1	.350			1366.76354	2285.63274	2444.754	3.524618	.084858	475.185
113	XCON012462 ABSORBER	17	.160	.000000	.00	1366.61566	2285.57316	2444.768	3.524618	.084858	475.345
114		1	.300			1366.33840	2285.46145	2444.793	3.524618	.084858	475.645
115	XWCA012463 MWPC 3,4	9	.320	.000000	.00	1366.04266	2285.34228	2444.820	3.524618	.084858	475.965
116	XTRI012463 TRIG1	9	.000	.000000	.00	1366.04266	2285.34228	2444.820	3.524618	.084858	475.965

I	ELEMENT	K	L	ANGLE		X	Y	Z	ANGLE		LENGTH
				M RAD	DEG				M	RAD	
117		1	.335			1365.73305	2285.21753	2444.849	3.524618	.084858	476.300
118	MDXH012464 GAP=100.TRIM 5. INV	13	.400	.000000	.00	1365.36337	2285.06858	2444.882	3.524618	.084858	476.700
119		1	.484			1364.91606	2284.88835	2444.923	3.524618	.084858	477.184
120	MBE 012468 B3. S3 MODEL INV:	8	6.200	.011022	74.20	1359.18700	2282.56993	2445.416	3.527628	.074252	483.384
121		1	.440			1358.78050	2282.40472	2445.449	3.527628	.074252	483.824
122	MBE 012474 B3. S3 MODEL INV:	8	6.200	.011022	74.20	1353.05392	2280.06724	2445.876	3.530634	.063645	490.024
123		1	.726			1352.38353	2279.79242	2445.922	3.530634	.063645	490.750
124	MCB 012480 B4	8	2.500	.004033	.00	1350.07695	2278.84143	2446.081	3.534675	.063645	493.250
125		1	.800			1349.33946	2278.53562	2446.132	3.534675	.063645	494.050
126	MCB 012483 B4	8	2.500	.004033	.00	1347.03674	2277.57531	2446.291	3.538716	.063644	496.550
127		1	.714			1346.37963	2277.29971	2446.336	3.538716	.063644	497.264
128	MBE 012488 B3. S3 MODEL INV:	8	6.200	.011022	74.20	1340.67547	2274.89726	2446.698	3.541721	.053038	503.464
129		1	.440			1340.27079	2274.72610	2446.721	3.541721	.053038	503.904
130	MBE 012494 B3. S3 MODEL INV:	8	6.200	.011022	74.20	1334.57066	2272.30516	2447.017	3.544725	.042431	524.823
131	TT60 TO TT4	1	14.719			1321.04377	2266.53607	2447.642	3.544725	.042431	524.823
132	TT4 WALL	1	.000			1321.04377	2266.53607	2447.642	3.544725	.042431	524.823
133		1	10.025			1311.83070	2262.60679	2448.067	3.544725	.042431	534.848
134		1	1.150			1310.77384	2262.15605	2448.116	3.544725	.042431	535.998
135		1	1.375			1309.51021	2261.61712	2448.174	3.544725	.042431	537.373
136	MBE 012528 B5 EPB MODEL INV:	8	6.200	-.010924	-76.73	1303.80810	2259.19368	2448.404	3.542216	.031799	543.573
137		1	.551			1303.30099	2258.97891	2448.421	3.542216	.031799	544.124
138	QTL 012533 Q12	2	2.990			1300.54913	2257.81342	2448.517	3.542216	.031799	547.114
139		1	.464			1300.12209	2257.63255	2448.531	3.542216	.031799	547.578
140	MBE 012538 B5 EPB MODEL INV:	8	6.200	-.010924	-76.73	1294.41199	2255.22261	2448.695	3.539707	.021166	553.778
141		1	.551			1293.90420	2255.00905	2448.707	3.539707	.021166	554.329
142	QTL 012544 Q13	2	2.990			1291.14865	2253.85014	2448.770	3.539707	.021166	557.319
143		1	.440			1290.74315	2253.67960	2448.780	3.539707	.021166	557.759
144	QTL 012547 Q13	2	2.990			1287.98761	2252.52069	2448.843	3.539707	.021166	560.749
145		1	.385			1287.63280	2252.37147	2448.851	3.539707	.021166	561.134
146	MDXH012549 GAP=80.TRIM 6.	13	.400	.000000	.00	1287.26416	2252.21643	2448.860	3.539707	.021166	561.534
147		1	.335			1286.95543	2252.08659	2448.867	3.539707	.021166	561.869
148	XTRI012550 TRIG 2	9	.320	.000000	.00	1286.66052	2251.96256	2448.873	3.539707	.021166	562.189
149	XWCA012550 MWPC 5,6	9	.000	.000000	.00	1286.66052	2251.96256	2448.873	3.539707	.021166	562.189
150		1	.560			1286.14443	2251.74550	2448.885	3.539707	.021166	562.749
151	QTS 012551 Q14	2	1.490			1284.77127	2251.16799	2448.917	3.539707	.021166	564.239
152		1	.440			1284.36577	2250.99745	2448.926	3.539707	.021166	564.679
153	QTL 012554 Q14	2	2.990			1281.61023	2249.83854	2448.989	3.539707	.021166	567.669
154		1	.714			1280.95221	2249.56180	2449.005	3.539707	.021166	568.383
155	MCB 012557 B6	8	2.500	-.004033	.00	1278.64629	2248.59746	2449.057	3.535673	.021166	570.883
156		1	.800			1277.90778	2248.29036	2449.074	3.535673	.021166	571.683
157	MCB 012561 B6	8	2.500	-.004033	.00	1275.59799	2247.33534	2449.127	3.531639	.021166	574.183
158		1	.726			1274.92667	2247.05935	2449.143	3.531639	.021166	574.909
159	QTL 012564 Q14	2	2.990			1272.16186	2245.92271	2449.206	3.531639	.021166	577.899

I	ELEMENT	K	L	ANGLE		X	Y	Z	ANGLE		LENGTH
				M	DEG				M	RAD	
160		1	.440			1271.75500	2245.75545	2449.215	3.531639	.021166	578.339
161	QTS 012567 Q14	2	1.490			1270.37722	2245.18903	2449.247	3.531639	.021166	579.829
162		1	.484			1269.92968	2245.00504	2449.257	3.531639	.021166	580.313
163	MDSV012568 TRIM 7. CH: EPB	14	.700	.000000	.00	1269.28240	2244.73894	2449.272	3.531639	.021166	581.013
164		1	.816			1268.52785	2244.42874	2449.289	3.531639	.021166	581.829
165	QTL 012571 Q13	2	2.990			1265.76305	2243.29211	2449.352	3.531639	.021166	584.819
166		1	.440			1265.35619	2243.12484	2449.362	3.531639	.021166	585.259
167	QTL 012574 Q13	2	2.990			1262.59138	2241.98821	2449.425	3.531639	.021166	588.249
168		1	.464			1262.16233	2241.81182	2449.435	3.531639	.021166	588.713
169	MBE 012580 B5 EPB MODEL INV:	8	6.200	-.010924	-76.73	1256.42577	2239.46187	2449.533	3.529131	.010534	594.913
170		1	.551			1255.91566	2239.25366	2449.539	3.529131	.010534	595.464
171	QTL 012585 Q12	2	2.990			1253.14754	2238.12377	2449.570	3.529131	.010534	598.454
172		1	.464			1252.71798	2237.94843	2449.575	3.529131	.010534	598.918
173	MBE 012590 B5 EPB MODEL INV:	8	6.200	-.010924	-76.73	1246.97490	2235.61262	2449.608	3.526623	-.000099	605.118
174		1	.326			1246.67277	2235.49017	2449.608	3.526623	-.000099	605.444
175	XWCA012594 MWPC 7,8	9	.320	.000000	.00	1246.37619	2235.36999	2449.608	3.526623	-.000099	605.764
176		1	.244			1246.15006	2235.27834	2449.608	3.526623	-.000099	606.008
177	MDXH012595 GAP=120.TRIM 8.	13	.400	.000000	.00	1245.77934	2235.12811	2449.607	3.526623	-.000099	606.408
178		1	.370			1245.43643	2234.98914	2449.607	3.526623	-.000099	606.778
179	MDXV012596 GAP=100.TRIM 9.	14	.400	.000000	.00	1245.06572	2234.83891	2449.607	3.526623	-.000099	607.178
180		1	.235			1244.84792	2234.75064	2449.607	3.526623	-.000099	607.413
181	XCSV012597 C5	11	1.150	.000000	.00	1243.78212	2234.31872	2449.607	3.526623	-.000099	608.563
182		1	.686			1243.14634	2234.06107	2449.607	3.526623	-.000099	609.249
183	MSSB012598 B7(SPLIT)	8	4.700	.000000	.00	1238.79044	2232.29581	2449.607	3.526623	-.000099	613.949
184		1	.852			1238.00082	2231.97581	2449.607	3.526623	-.000099	614.801
185	MSSB012602 B7(SPLIT)	8	4.700	.000000	.00	1233.64492	2230.21055	2449.606	3.526623	-.000099	619.501
186		1	4.429			1229.54018	2228.54707	2449.606	3.526623	-.000099	623.930
187	MBPL012615 B8 ALIGN->X5	4	2.000	.000000	.00	1227.68661	2227.79590	2449.606	3.526623	-.000099	625.930
188		1	.900			1226.85250	2227.45787	2449.605	3.526623	-.000099	626.830
189	MBPL012619 B8 ALIGN->X5	4	2.000	.000000	.00	1224.99892	2226.70669	2449.605	3.526623	-.000099	628.830
190		1	2.676			1222.51884	2225.70162	2449.605	3.526623	-.000099	631.506
191		1	29.048			1195.59753	2214.79157	2449.602	3.526623	-.000099	660.554
192		1	7.952			1188.22772	2211.80490	2449.601	3.526623	-.000099	668.506
193	H3-DUMP DUMP	1	3.200			1185.26200	2210.60302	2449.601	3.526623	-.000099	671.706

Addendum: Beatch of the new transfer line towards T1

1 NEW TT60 EPB FOR WEST UPGRADING (400-450 GEV/C) 06.01.88
 GEOMETRIE
 0 04/02/99

I	ELEMENT	K	L	DEFL	TILT	X	Y	Z	HOR	VERT	HOR	HOR	VERT	BEAM
	INITIAL		2083.52788	2586.13130	2402.17934	271.92568	3.582583	.000045						
	REQUIRED FINAL		1794.77673	2456.52068	2408.84843	274.91442	3.535636	.043243						
	FH = 1.0000000 FV = 1.0000000													
1	EJECT PT	1	.0000	2083.52788	2586.13130	2402.17934	2586.13130	2402.17934	3.582583	.000045	.000	3.582583	.000045	.000
2		1	7.2448	2076.97619	2583.03896	2402.17967	2583.03896	2402.17967	3.582583	.000045	7.245	3.582583	.000045	7.245
3	MNAV610013	5	1.4000	.0000000	2075.71013	2582.44139	2402.17973	2402.17973	3.582583	.000045	8.645	3.582583	.000045	8.645
4		1	.3750		2075.37101	2582.28133	2402.17975	2402.17975	3.582583	.000045	9.020	3.582583	.000045	9.020
5	BPC1610015	1	.7200		2074.71989	2581.97401	2402.17978	2402.17978	3.582583	.000045	9.740	3.582583	.000045	9.740
6		1	.1370		2074.59600	2581.91553	2402.17978	2402.17978	3.582583	.000045	9.877	3.582583	.000045	9.877
7	BSG 610017	1	.4500		2074.18905	2581.72346	2402.17980	2402.17980	3.582583	.000045	10.327	3.582583	.000045	10.327
8		1	.1370		2074.06516	2581.66498	2402.17981	2402.17981	3.582583	.000045	10.464	3.582583	.000045	10.464
9	BSG 610018	1	.4500		2073.65821	2581.47291	2402.17983	2402.17983	3.582583	.000045	10.914	3.582583	.000045	10.914
10		1	.1370		2073.53432	2581.41443	2402.17984	2402.17984	3.582583	.000045	11.051	3.582583	.000045	11.051
11	BTV 610018	1	.4500		2073.12737	2581.22235	2402.17986	2402.17986	3.582583	.000045	11.501	3.582583	.000045	11.501
12		1	.3100		2072.84703	2581.09003	2402.17987	2402.17987	3.582583	.000045	11.811	3.582583	.000045	11.811
13	QTL610100	3	2.9900		2070.14308	2579.81380	2402.18001	2402.18001	3.582583	.000045	14.801	3.582583	.000045	14.801
14		1	.6200		2069.58240	2579.54916	2402.18003	2402.18003	3.582583	.000045	15.421	3.582583	.000045	15.421
15	MDLH610104	4	1.4000	-.0007437	2068.31611	2578.95206	2402.18010	2402.18010	3.581839	.000045	16.821	3.581839	.000045	16.821
16		1	.6550		2067.72357	2578.67292	2402.18013	2402.18013	3.581839	.000045	17.476	3.581839	.000045	17.476
17	IMCV180011	1	1.9000		2066.00474	2577.86321	2402.18021	2402.18021	3.581839	.000045	19.376	3.581839	.000045	19.376
18		1	27.0678		2041.51795	2566.32793	2402.18143	2402.18143	3.581839	.000045	46.444	3.581839	.000045	46.444
19	BSG 610143	1	.4500		2041.11086	2566.13616	2402.18145	2402.18145	3.581839	.000045	46.894	3.581839	.000045	46.894
20		1	.4230		2040.72819	2565.95589	2402.18147	2402.18147	3.581839	.000045	47.317	3.581839	.000045	47.317
21	QTLF610200	2	2.9900		2038.02330	2564.68166	2402.18160	2402.18160	3.581839	.000045	50.307	3.581839	.000045	50.307
22		1	.5525		2037.52348	2564.44621	2402.18163	2402.18163	3.581839	.000045	50.859	3.581839	.000045	50.859
23	MDCA610204	1	.3000		2037.25209	2564.31836	2402.18164	2402.18164	3.581839	.000045	51.159	3.581839	.000045	51.159

24	1	1.3630				2036.01906	2563.73750	2402.18170	52.522	3.581839	.000045	52.522
25	MDLH610206	4	1.4000	-.0007558	.00000	2034.75232	2563.14135	2402.18177	53.922	3.581083	.000045	53.922
26		1	1.6970			2033.21659	2562.41932	2402.18184	55.619	3.581083	.000045	55.619
27	BSP 610210	1	.4500			2032.80936	2562.22785	2402.18186	56.069	3.581083	.000045	56.069
28		1	.5160			2032.34239	2562.00830	2402.18189	56.585	3.581083	.000045	56.585
29	BPCL610211	1	.7200			2031.69082	2561.70196	2402.18192	57.305	3.581083	.000045	57.305
30		1	.7300			2031.03019	2561.39136	2402.18195	58.035	3.581083	.000045	58.035
31	BS1610213E	1	.4500			2030.62295	2561.19989	2402.18197	58.485	3.581083	.000045	58.485
32	VEBG610226	1	10.3460			2021.26015	2556.79789	2402.18244	68.831	3.581083	.000045	68.831
33	VEBT610227	1	.8600			2020.85291	2556.60642	2402.18246	69.281	3.581083	.000045	69.281
34		1	19.5040			2020.07464	2556.24051	2402.18250	70.141	3.581083	.000045	70.141
35		1	.8600			2002.42414	2547.94198	2402.18337	89.645	3.581083	.000045	89.645
36	BCT 610253	1	.8600			2001.64586	2547.57606	2402.18341	90.505	3.581083	.000045	90.505
37		1	1.1730			2000.58434	2547.07698	2402.18347	91.678	3.581083	.000045	91.678
38	QTL610300	3	2.9900			1997.87848	2545.80480	2402.18360	94.668	3.581083	.000045	94.668
39		1	.7330			1997.21514	2545.49292	2402.18363	95.401	3.581083	.000045	95.401
40	MDLV610304	5	1.4000	.0005047	-90.00000	1995.94818	2544.89725	2402.18405	96.801	3.581083	.000550	96.801
41		1	.4880			1995.50656	2544.68962	2402.18432	97.289	3.581083	.000550	97.289
42	BSPV610307	1	.4500			1995.09932	2544.49815	2402.18456	97.739	3.581083	.000550	97.739
43		1	.2500			1994.87308	2544.39178	2402.18470	97.989	3.581083	.000550	97.989
44	BCT 610307	1	.8600			1994.09481	2544.02587	2402.18517	98.849	3.581083	.000550	98.849
45		1	.8500			1993.32558	2543.66421	2402.18564	99.699	3.581083	.000550	99.699
46	BSG 610310	1	.4500			1992.91835	2543.47275	2402.18589	100.149	3.581083	.000550	100.149
47		1	.7970			1992.19709	2543.13364	2402.18633	100.946	3.581083	.000550	100.946
48	BSI 610311	1	.4500			1991.78985	2542.94218	2402.18657	101.396	3.581083	.000550	101.396
49		1	.1370			1991.66587	2542.88389	2402.18665	101.533	3.581083	.000550	101.533
50	BPCL610312	1	.7200			1991.01430	2542.57754	2402.18705	102.253	3.581083	.000550	102.253
51		1	2.3430			1988.89396	2541.58064	2402.18833	104.596	3.581083	.000550	104.596
52	BSG 610316	1	.4500			1988.48672	2541.38918	2402.18858	105.046	3.581083	.000550	105.046
53		1	.2500			1988.26048	2541.28281	2402.18872	105.296	3.581083	.000550	105.296
54	BTV 610317	1	.4500			1987.85324	2541.09134	2402.18897	105.746	3.581083	.000550	105.746
55		1	3.4075			1984.76956	2539.64153	2402.19084	109.154	3.581083	.000550	109.154
56	TED 610321	1	4.7500			1980.47096	2537.62050	2402.19345	113.904	3.581083	.000550	113.904
57		1	9.9715			1971.44707	2533.37784	2402.19893	123.875	3.581083	.000550	123.875
58	BPCL610340	1	.7200			1970.79549	2533.07150	2402.19933	124.595	3.581083	.000550	124.595
59		1	3.100			1970.51495	2532.93960	2402.19950	124.905	3.581083	.000550	124.905
60	QTLF610400	2	2.9900			1967.80910	2531.66742	2402.20114	127.895	3.581083	.000550	127.895
61		1	.5030			1967.35390	2531.45340	2402.20142	128.398	3.581083	.000550	128.398
62	BSPH610404	1	.4500			1966.94666	2531.26194	2402.20166	128.848	3.581083	.000550	128.848
63		1	.4760			1966.51590	2531.05941	2402.20193	129.324	3.581083	.000550	129.324
64	MBB 610405	4	6.2000	-.0082771	.00013	1960.89423	2528.44468	2402.20533	135.524	3.572806	.000550	135.524
65		1	.4400			1960.49450	2528.26078	2402.20558	135.964	3.572806	.000550	135.964
66	MBB 610413	4	6.2000	-.0082771	.00013	1954.85138	2525.69267	2402.20898	142.164	3.564529	.000550	142.164
67		1	.5770			1954.32522	2525.45585	2402.20930	142.741	3.564529	.000550	142.741
68	MBE 610422	5	6.2000	.0083962	-90.00000	1948.67158	2522.91115	2402.23874	148.941	3.564529	.008946	148.941
69		1	.4400			1948.27037	2522.73056	2402.24267	149.381	3.564529	.008946	149.381
70	MBE 610430	5	6.2000	.0083962	-90.00000	1942.61715	2520.18605	2402.32416	155.580	3.564529	.017342	155.581

71		1	.4400				1942.21598	2520.00549	2402.33179	156.020	3.564529	.017342	156.021
72	MBE 610438	5	6.2000	.0083962	-90.00000		1936.56359	2517.46135	2402.46533	162.219	3.564529	.025738	162.221
73		1	1.0450				1935.61099	2517.03258	2402.49223	163.264	3.564529	.025738	163.266
74	QTL610500	3	2.9900				1932.88535	2515.80577	2402.56917	166.253	3.564529	.025738	166.256
75		1	.5030				1932.42682	2515.59939	2402.58212	166.755	3.564529	.025738	166.759
76	BSPV610504	1	.4500				1932.01660	2515.41475	2402.59370	167.205	3.564529	.025738	167.209
77		1	.2500				1931.78871	2515.31218	2402.60013	167.455	3.564529	.025738	167.459
78	BSG 610505	1	.4500				1930.82060	2515.12754	2402.61172	167.905	3.564529	.025738	167.909
79		1	.6120				1930.82060	2514.87643	2402.62747	168.517	3.564529	.025738	168.521
80	MBE 610506	5	6.2000	.0083962	-90.00000		1925.16943	2512.33284	2402.81304	174.714	3.564529	.034135	174.721
81		1	.4400				1924.76844	2512.15236	2402.82806	175.154	3.564529	.034135	175.161
82	MBE 610514	5	6.2000	.0083962	-90.00000		1919.11889	2509.60950	2403.06566	181.349	3.564529	.042531	181.361
83		1	.5770				1918.59320	2509.37289	2403.09020	181.926	3.564529	.042531	181.938
84	MBB 610523	4	6.2000	-.0082769	.01009		1912.93413	2506.85388	2403.35381	188.120	3.556245	.042531	188.138
85		1	.4400				1912.53178	2506.67678	2403.37252	188.560	3.556245	.042531	188.578
86	MBB 610531	4	6.2000	-.0082769	.01009		1906.85204	2504.20474	2403.63613	194.754	3.547960	.042531	194.778
87		1	.2894				1906.58644	2504.09045	2403.64844	195.043	3.547960	.042531	195.067
88	BPK610539	1	.4500				1906.17346	2503.91273	2403.66757	195.493	3.547960	.042531	195.517
89		1	.1370				1906.04774	2503.85863	2403.67340	195.630	3.547960	.042531	195.654
90	BSPH610540	1	.4500				1905.63476	2503.68092	2403.69253	196.079	3.547960	.042531	196.104
91		1	.3100				1905.35026	2503.55849	2403.70571	196.389	3.547960	.042531	196.414
92	QTLF610600	2	2.9900				1902.60624	2502.37769	2403.83284	199.376	3.547960	.042531	199.404
93		1	.6700				1901.99136	2502.11309	2403.86133	200.046	3.547960	.042531	200.074
94	MBS 660004	4	3.0000	-.0029308	.00357		1899.23643	2500.93238	2403.98888	203.043	3.545027	.042531	203.074
95		1	.6400				1898.64834	2500.68135	2404.01609	203.682	3.545027	.042531	203.714
96	MBS 660009	4	3.0000	-.0029308	.00357		1895.88996	2499.50873	2404.14364	206.680	3.542094	.042531	206.714
97		1	.6400				1895.30114	2499.25943	2404.17086	207.319	3.542094	.042531	207.354
98	MBS 660013	4	3.0000	-.0029308	.00357		1892.53933	2498.09490	2404.29841	210.316	3.539160	.042531	210.354
99		1	9.4630				1883.82228	2494.43436	2404.70076	219.771	3.539160	.042531	219.817
100	MBS 660029	4	3.0000	-.0029308	.00357		1881.05707	2493.27793	2404.82831	222.768	3.536227	.042531	222.817
101		1	.6400				1880.46679	2493.03209	2404.85552	223.408	3.536227	.042531	223.457
102	MBS 660033	4	3.0000	-.0029308	.00357		1877.69820	2491.88378	2404.98308	226.405	3.533293	.042531	226.457
103		1	.6400				1877.10720	2491.63968	2405.01029	227.044	3.533293	.042531	227.097
104	MBS 660038	4	3.0000	-.0029308	.00357		1874.33525	2490.49950	2405.13784	230.042	3.530360	.042531	230.097
105		1	.6400				1873.74355	2490.25713	2405.16505	230.681	3.530360	.042531	230.737
106	MBS 660042	4	3.0000	-.0029308	.00357		1870.96826	2489.12508	2405.29261	233.678	3.527426	.042531	233.737
107		1	.6400				1870.37585	2488.88445	2405.31982	234.318	3.527426	.042531	234.377
108	MBS 660047	4	3.0000	-.0029308	.00357		1867.59726	2487.76055	2405.44737	237.315	3.524493	.042531	237.377
109		1	.5330				1867.10330	2487.56159	2405.47004	237.848	3.524493	.042531	237.910
110	QTL660100	2	2.9900				1864.33233	2486.44550	2405.59717	240.835	3.524493	.042531	240.900
111		1	1.3809				1863.05259	2485.93005	2405.65588	242.214	3.524493	.042531	242.281
112	BSP660105	1	.4500				1862.63555	2485.76207	2405.67501	242.664	3.524493	.042531	242.731
113		1	.4800				1862.19071	2485.58290	2405.69542	243.144	3.524493	.042531	243.211
114	MDSV660106	5	.7000	.0000000	-90.00000		1861.54199	2485.32161	2405.72518	243.843	3.524493	.042531	243.911
115		1	.7680				1860.83025	2485.03493	2405.75784	244.610	3.524493	.042531	244.679
116	MBS 660108	1	3.0000				1858.05001	2483.91511	2405.88539	247.608	3.524493	.042531	247.679
117		1	.6400				1857.45689	2483.67622	2405.91260	248.247	3.524493	.042531	248.319

118	MBS	660113	1	3.0000	1854.67665	2482.55639	2406.04016	251.244	3.524493	.042531	251.319
119			1	.6400	1854.08354	2482.31750	2406.06737	251.884	3.524493	.042531	251.959
120	MBS	660117	1	3.0000	1851.30330	2481.19767	2406.19492	254.881	3.524493	.042531	254.959
121			1	31.1320	1822.45184	2469.57690	2407.51859	285.985	3.524493	.042531	286.091
122	BSP	670030	1	.4500	1822.03480	2469.40892	2407.53772	286.434	3.524493	.042531	286.541
123			1	.2500	1821.80311	2469.31560	2407.54835	286.684	3.524493	.042531	286.791
124			1	.1730	1821.64279	2469.25103	2407.55571	286.857	3.524493	.042531	286.964
125	QTL	670100	3	2.9900	1818.87181	2468.13494	2407.68284	289.844	3.524493	.042531	289.954
126			1	.2530	1818.63735	2468.04050	2407.69360	290.097	3.524493	.042531	290.207
127			1	.5260	1818.14988	2467.84416	2407.71596	290.623	3.524493	.042531	290.733
128			1	.2260	1817.94044	2467.75980	2407.72557	290.848	3.524493	.042531	290.959
129	MBBT670105	8	6.2000	.0055780	1812.20112	2465.42952	2407.99028	297.043	3.530065	.042887	297.159
130			1	.2140	1812.00325	2465.34853	2407.99946	297.257	3.530065	.042887	297.373
131			1	.2260	1811.79428	2465.26301	2408.00915	297.482	3.530065	.042887	297.599
132	MBBT670113	8	6.2000	.0055780	1806.06813	2462.90082	2408.27607	303.677	3.535636	.043243	303.799
133			1	.2140	1805.87071	2462.81874	2408.28532	303.890	3.535636	.043243	304.013
134			1	.6180	1805.30061	2462.58169	2408.31204	304.508	3.535636	.043243	304.631
135			1	.1730	1805.14101	2462.51534	2408.31952	304.681	3.535636	.043243	304.804
136	QTL	670200	3	2.9900	1802.38274	2461.36847	2408.44877	307.668	3.535636	.043243	307.794
137			1	.2530	1802.14934	2461.27143	2408.45971	307.921	3.535636	.043243	308.047
138			1	.2500	1801.91872	2461.17554	2408.47052	308.170	3.535636	.043243	308.297
139			1	.2300	1801.70654	2461.08732	2408.48046	308.400	3.535636	.043243	308.527
140	MDSH670205	4	.7000	.0000000	1801.06079	2460.81882	2408.51072	309.100	3.535636	.043243	309.227
141			1	.2380	1800.84124	2460.72753	2408.52101	309.337	3.535636	.043243	309.465
142			1	.1660	1800.68810	2460.66386	2408.52819	309.503	3.535636	.043243	309.631
143			1	.1730	1800.52851	2460.59751	2408.53567	309.676	3.535636	.043243	309.804
144	QTL	670300	3	2.9900	1797.77023	2459.45064	2408.66492	312.663	3.535636	.043243	312.794
145			1	.2530	1797.53684	2459.35360	2408.67586	312.916	3.535636	.043243	313.047
146			1	.5840	1796.99810	2459.12960	2408.70111	313.499	3.535636	.043243	313.631
147			1	.1730	1796.83851	2459.06324	2408.70858	313.672	3.535636	.043243	313.804
148	QTL	670305	3	2.9900	1794.08023	2457.91638	2408.83784	316.660	3.535636	.043243	316.794
149			1	.2530	1793.84684	2457.81933	2408.84878	316.912	3.535636	.043243	317.047
150			1	.2500	1793.61621	2457.72344	2408.85959	317.162	3.535636	.043243	317.297
151			1	.2300	1793.40404	2457.63522	2408.86953	317.392	3.535636	.043243	317.527
152	MDSV670310	5	.7000	.0000000	1792.75828	2457.36673	2408.89979	318.091	3.535636	.043243	318.227
153			1	.2380	1792.53873	2457.27544	2408.91008	318.329	3.535636	.043243	318.465
154			1	.2500	1792.30810	2457.17954	2408.92089	318.579	3.535636	.043243	318.715
155			1	.2300	1792.09593	2457.09132	2408.93083	318.809	3.535636	.043243	318.945
156	MDSH670312	4	.7000	.0000000	1791.45018	2456.82283	2408.96109	319.508	3.535636	.043243	319.645
157			1	.2380	1791.23062	2456.73154	2408.97138	319.746	3.535636	.043243	319.883
158			1	.2500	1791.00000	2456.63565	2408.98218	319.995	3.535636	.043243	320.133
159	BSM	670313	1	.4500	1790.58487	2456.46304	2409.00164	320.445	3.535636	.043243	320.583
160			1	6.6960	1784.40781	2453.89468	2409.29110	327.135	3.535636	.043243	327.279
161	TBIU		1	.2500	1784.17718	2453.79879	2409.30191	327.384	3.535636	.043243	327.529
162			1	.4000	1783.80818	2453.64536	2409.31920	327.784	3.535636	.043243	327.929
163	NEW T1 CEN		1	.0000	1783.80818	2453.64536	2409.31920	327.784	3.535636	.043243	327.929
164			1	.3500	1783.48531	2453.51112	2409.33433	328.134	3.535636	.043243	328.279

165 TBID 1 .2500 1783.25468 2453.41522 2409.34514 328.384 3.535636 .043243 328.529