Rev.04 of Mar. 28, 2002

Doses from the LAr beam pipe

Here are given results of simulations of dose rate that results from activation of the beam pipe section placed inside the LAr End Cap Calorimeter (Zmin=365 cm, Zmax=870 cm).

All tubes and bellows excluded between Z=365 and 449.5.

Table 1

Material zones of the LAr beam pipe section

##	Z_{min}, cm	Z_{max}, cm	R_{min}, cm	R_{max}, cm	Mass, kg(*	Comment
1	365	366.4	2.9	4.3	0.346	Flange
2	397	397.08	2.98	8.3	0.118	Pump wall
3	397.08	402.6	8.23	8.3	0.156	Pump wall
4	402.6	402.68	2.98	8.3	0.118	Pump wall
5	398.6	401.8	4.5	4.7	0.144	Electrode
6	398.6	401.8	6.8	7	0.216	Electrode
7	449.5	855	2.9	2.98	4.672	Tube
8	855	863.2	2.9	3.04	0.167	Bellows
9	863.2	870	2.9	2.98	0.078	Tube
10	449.5	849	3.92	4	6.199	Tube
11	868.6	870	2.98	4.3	0.330	Flange
(* - calculated as product of density by volume						

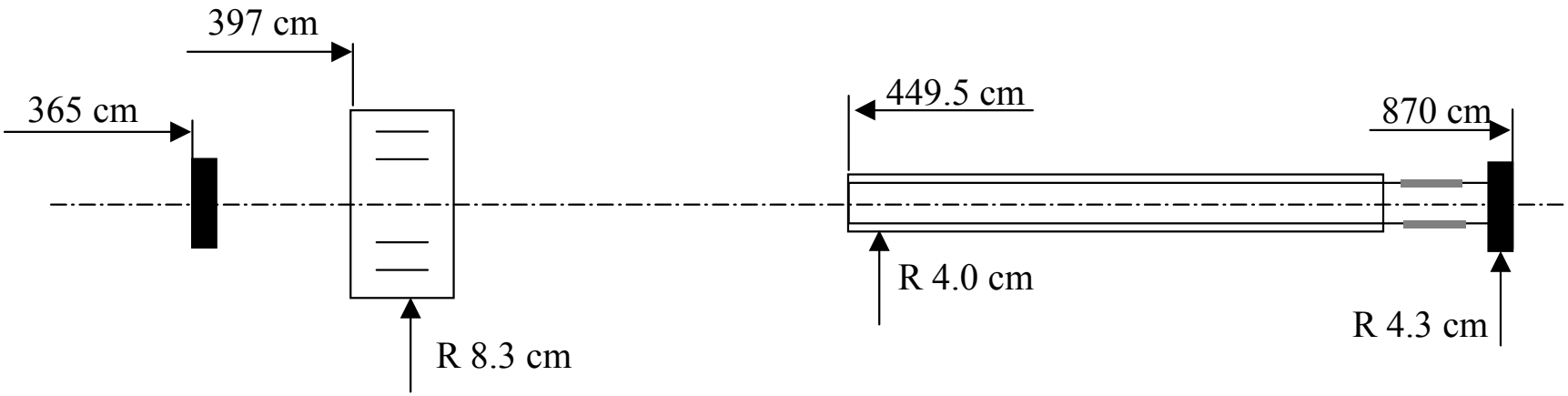

Fig. 1. Sketch of the LAr Beam pipe section.

Table 2

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 100d, t=5d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	353	3343	1962	648	640								3663	734
5	334	3809	1557	619	618	2927	8717	6638	5104	4534	4480	2876	3667	671
7	317	1377	1050	589	596	1899	5376	4213	3257	2899	2829	1928	1638	615
10	286	665	633	529	549	1324	3431	2787	2167	1930	1852	1296	935	524
15	234	365	380	419	462	916	2084	1784	1398	1246	1168	829	571	403
20	194	265	282	332	391	710	1454	1302	1029	916	843	600	422	325
25	168	215	230	273	339	581	1093	1018	810	721	652	465	338	273
50	109	127	134	155	206	295	430	454	375	333	286	210	173	154
75	85	96	100	113	143	185	242	269	230	205	173	133	115	107
100	69	77	79	88	106	129	159	179	158	141	120	96	86	81
125	58	63	65	70	82	96	113	128	116	104	90	74	67	64
150	49	53	54	58	65	74	85	96	89	80	70	59	55	52
175	42	44	45	48	53	59	67	74	70	64	57	49	46	44
200	36	38	38	40	44	49	54	59	56	52	47	41	39	37
225	31	33	33	34	37	40	44	48	46	43	39	35	33	32

Table 2 (continuation)

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 10y, t=5d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	397	3754	2203	729	721								4120	826
5	376	4277	1749	695	696	3303	9859	7480	5742	5102	5040	3235	4125	755
7	357	1547	1179	662	670	2143	6079	4748	3664	3263	3182	2168	1842	692
10	321	747	712	595	618	1495	3879	3141	2438	2172	2084	1458	1052	590
15	263	411	428	472	520	1034	2356	2010	1573	1402	1314	932	642	453
20	219	298	317	374	440	801	1644	1468	1157	1031	948	675	474	366
25	189	242	259	307	382	656	1235	1147	912	812	734	523	380	307
50	123	143	151	174	233	332	486	512	423	375	322	237	194	173
75	95	108	113	127	162	209	273	303	260	230	195	150	130	120
100	78	87	90	99	120	146	179	202	178	159	135	108	96	91
125	65	71	73	79	93	108	128	144	131	117	101	83	76	72
150	55	59	61	65	74	84	96	108	100	91	79	67	62	59
175	47	50	51	54	60	67	75	84	78	72	64	55	51	49
200	40	43	43	46	50	55	61	67	63	59	53	46	43	42
225	35	37	37	39	42	46	50	54	52	49	44	39	37	36

Table 2 (continuation)

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 100d, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	60	557	328	112	112								636	128
5	57	634	261	107	108	516	1596	1193	903	793	781	501	636	117
7	54	231	176	102	104	336	983	757	576	507	493	336	284	107
10	49	112	107	92	96	236	627	501	383	338	323	226	163	91
15	40	62	65	73	81	164	380	320	247	218	204	144	99	70
20	34	46	49	58	69	127	265	234	182	161	147	105	74	57
25	29	37	40	48	60	104	199	183	143	127	114	81	59	48
50	19	23	24	27	37	53	78	82	67	59	50	37	30	27
75	15	17	18	20	26	33	44	48	41	36	31	23	20	19
100	12	14	14	16	19	23	29	32	28	25	21	17	15	14
125	10	11	12	13	15	17	20	23	21	19	16	13	12	11
150	8.8	9.4	9.6	10	12	13	15	17	16	14	12	10	9.7	9.3
175	7.5	7.9	8.1	8.6	9.6	11	12	13	12	11	10	8.6	8.1	7.8
200	6.4	6.8	6.9	7.2	7.9	8.7	9.6	11	10	9.2	8.3	7.3	6.8	6.6
225	5.6	5.8	5.9	6.2	6.7	7.2	7.9	8.6	8.2	7.7	7.0	6.2	5.9	5.7

Table 2 (continuation)

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 10y, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	91	845	497	168	169								959	192
5	86	963	395	161	163	780	2391	1780	1351	1192	1177	754	959	176
7	82	350	267	153	157	508	1473	1129	862	763	743	505	429	161
10	74	170	162	138	145	355	939	747	573	508	487	340	245	137
15	61	94	98	109	122	246	570	478	370	328	307	217	150	106
20	51	69	74	87	104	191	397	349	272	242	222	157	111	85
25	44	56	60	72	90	157	298	273	214	190	172	122	89	72
50	29	34	36	41	55	80	117	122	100	88	76	55	45	41
75	23	26	27	30	39	50	65	72	61	54	46	35	30	28
100	19	21	21	24	29	35	43	48	42	38	32	25	23	21
125	16	17	17	19	22	26	31	34	31	28	24	20	18	17
150	13	14	14	15	18	20	23	26	24	21	19	16	15	14
175	11	12	12	13	14	16	18	20	19	17	15	13	12	12
200	10	10	10	11	12	13	14	16	15	14	12	11	10	9.9
225	8.4	8.7	8.9	9.3	10	11	12	13	12	11	10	9.3	8.8	8.6

Table 3

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 100d, t=5d

R/Z, Cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	11.1	74.6	47.2	27.2	30.7								73.2	15.3
5	10.6	87.2	39.0	26.2	29.8	106.9	574.9	267.3	110.3	99.0	92.3	51.7	80.7	14.0
7	10.3	34.4	28.2	25.1	28.8	75.9	348.5	167.3	71.0	63.1	58.1	35.7	33.9	12.9
10	9.6	19.1	19.2	22.8	26.7	58.0	219.2	110.2	48.2	42.3	38.4	24.8	19.0	11.0
15	8.4	12.5	13.5	18.3	22.5	43.8	130.2	70.8	32.2	27.8	24.6	16.5	11.7	8.5
20	7.5	10.2	11.1	14.7	19.1	35.6	88.9	52.0	24.5	20.8	18.1	12.3	8.8	7.0
25	6.9	8.9	9.7	12.3	16.7	30.0	65.4	41.0	19.9	16.7	14.3	9.8	7.3	6.0
50	5.1	6.0	6.4	7.5	10.4	15.6	23.6	18.8	10.5	8.5	6.9	5.0	4.1	3.7
75	4.1	4.7	4.9	5.6	7.2	9.6	12.5	11.2	7.0	5.7	4.5	3.4	3.0	2.8
100	3.4	3.8	3.9	4.4	5.3	6.5	7.8	7.5	5.2	4.2	3.4	2.7	2.4	2.2
125	2.9	3.1	3.2	3.5	4.0	4.7	5.4	5.3	4.0	3.3	2.7	2.2	2.0	1.9
150	2.4	2.6	2.7	2.8	3.2	3.6	4.0	4.0	3.2	2.7	2.2	1.8	1.7	1.6
175	2.1	2.2	2.2	2.3	2.6	2.8	3.1	3.1	2.6	2.2	1.9	1.6	1.5	1.4
200	1.8	1.9	1.9	2.0	2.1	2.3	2.4	2.5	2.1	1.9	1.6	1.4	1.3	1.3
225	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.0	1.8	1.6	1.4	1.2	1.2	1.1

Table 3 (continuation)

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 10y, t=5d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	19.7	134.4	87.0	63.5	67.3								97.7	20.4
5	19.0	159.2	72.4	60.7	64.8	171.7	757.5	337.3	147.0	131.9	122.8	69.0	108.1	18.7
7	18.3	63.1	52.9	57.8	62.0	117.8	458.8	211.6	94.4	84.0	77.3	47.6	45.3	17.2
10	17.0	35.4	36.6	51.5	56.2	87.5	288.4	139.8	64.1	56.4	51.1	33.0	25.4	14.7
15	14.9	23.3	25.9	39.6	44.8	64.5	171.4	90.0	42.8	37.0	32.8	22.0	15.6	11.4
20	13.1	18.8	20.9	30.1	35.7	51.8	117.1	66.4	32.5	27.7	24.1	16.4	11.8	9.3
25	11.8	16.1	17.7	23.8	29.5	43.2	86.3	52.4	26.4	22.2	19.0	13.1	9.7	8.0
50	8.2	9.7	10.3	12.0	15.9	22.0	31.4	24.3	13.8	11.2	9.1	6.6	5.5	4.9
75	6.3	7.1	7.4	8.3	10.5	13.4	16.7	14.6	9.3	7.5	6.0	4.5	4.0	3.7
100	5.0	5.5	5.7	6.3	7.5	9.0	10.5	9.8	6.8	5.6	4.5	3.5	3.2	3.0
125	4.1	4.5	4.6	4.9	5.7	6.5	7.3	7.0	5.3	4.4	3.6	2.9	2.6	2.5
150	3.4	3.7	3.7	4.0	4.4	4.9	5.4	5.3	4.2	3.6	3.0	2.5	2.3	2.2
175	2.9	3.0	3.1	3.2	3.5	3.8	4.1	4.1	3.4	3.0	2.5	2.1	2.0	1.9
200	2.5	2.6	2.6	2.7	2.9	3.1	3.3	3.3	2.8	2.5	2.2	1.8	1.7	1.7
225	2.1	2.2	2.2	2.3	2.4	2.6	2.7	2.7	2.4	2.1	1.9	1.6	1.5	1.5

Table 3 (continuation)

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 100d, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	5.1	34.7	22.0	13.4	14.9								32.1	6.7
5	4.9	40.7	18.2	12.9	14.4	48.4	250.1	115.5	48.3	43.4	40.4	22.7	35.4	6.1
7	4.8	16.0	13.2	12.3	13.9	34.1	151.6	72.4	31.1	27.6	25.4	15.6	14.9	5.6
10	4.4	8.9	9.0	11.1	12.8	25.9	95.3	47.7	21.1	18.5	16.8	10.9	8.3	4.8
15	3.9	5.9	6.4	8.8	10.7	19.5	56.6	30.6	14.1	12.2	10.8	7.2	5.1	3.7
20	3.5	4.7	5.2	7.0	8.9	15.8	38.7	22.5	10.7	9.1	7.9	5.4	3.9	3.1
25	3.1	4.1	4.5	5.8	7.7	13.3	28.5	17.8	8.7	7.3	6.2	4.3	3.2	2.6
50	2.3	2.7	2.9	3.4	4.6	6.9	10.3	8.2	4.6	3.7	3.0	2.2	1.8	1.6
75	1.8	2.1	2.2	2.5	3.2	4.2	5.4	4.9	3.1	2.5	2.0	1.5	1.3	1.2
100	1.5	1.7	1.7	1.9	2.3	2.9	3.4	3.3	2.3	1.8	1.5	1.2	1.0	1.0
125	1.3	1.4	1.4	1.5	1.8	2.1	2.4	2.3	1.7	1.5	1.2	1.0	0.9	0.8
150	1.1	1.1	1.2	1.2	1.4	1.6	1.7	1.7	1.4	1.2	1.0	0.8	0.7	0.7
175	0.9	1.0	1.0	1.0	1.1	1.2	1.3	1.3	1.1	1.0	0.8	0.7	0.6	0.6
200	0.8	0.8	0.8	0.9	0.9	1.0	1.1	1.1	0.9	0.8	0.7	0.6	0.6	0.6
225	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.8	0.7	0.6	0.5	0.5	0.5

Table 3 (continuation)

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 10y, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	12.7	86.8	57.0	46.7	48.2								49.5	10.4
5	12.2	103.6	47.6	44.6	46.2	102.6	377.4	160.0	74.2	66.7	62.0	34.9	54.9	9.5
7	11.7	41.2	35.0	42.3	44.1	68.5	228.3	100.6	47.6	42.4	39.0	24.1	23.0	8.7
10	10.9	23.3	24.4	37.5	39.5	49.7	143.4	66.7	32.3	28.5	25.8	16.7	12.8	7.4
15	9.5	15.4	17.3	28.2	30.6	35.8	85.2	43.1	21.5	18.7	16.5	11.1	7.9	5.8
20	8.3	12.3	13.9	20.8	23.6	28.5	58.3	31.9	16.3	14.0	12.2	8.3	6.0	4.7
25	7.4	10.4	11.6	16.0	18.8	23.6	43.1	25.3	13.2	11.2	9.6	6.6	4.9	4.0
50	4.9	5.8	6.2	7.2	9.1	11.8	15.8	11.9	6.9	5.6	4.6	3.3	2.8	2.5
75	3.6	4.0	4.2	4.7	5.8	7.1	8.5	7.2	4.6	3.8	3.0	2.3	2.0	1.9
100	2.8	3.0	3.1	3.4	4.0	4.7	5.4	4.9	3.4	2.8	2.3	1.8	1.6	1.5
125	2.2	2.4	2.5	2.6	3.0	3.4	3.7	3.5	2.6	2.2	1.8	1.5	1.3	1.3
150	1.8	1.9	2.0	2.1	2.3	2.6	2.8	2.7	2.1	1.8	1.5	1.2	1.1	1.1
175	1.5	1.6	1.6	1.7	1.9	2.0	2.1	2.1	1.7	1.5	1.3	1.1	1.0	1.0
200	1.3	1.4	1.4	1.4	1.5	1.6	1.7	1.7	1.4	1.3	1.1	0.9	0.9	0.8
225	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.2	1.1	1.0	0.8	0.8	0.8