SUPERCONDUCTING SOLENOIDS - SHIELDING STUDIES 2.

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Energy deposition from MARS+MCNP codes.

STANDARD GEOMETRY,STANDARD SHIELDING(80%WC+20% H2O)

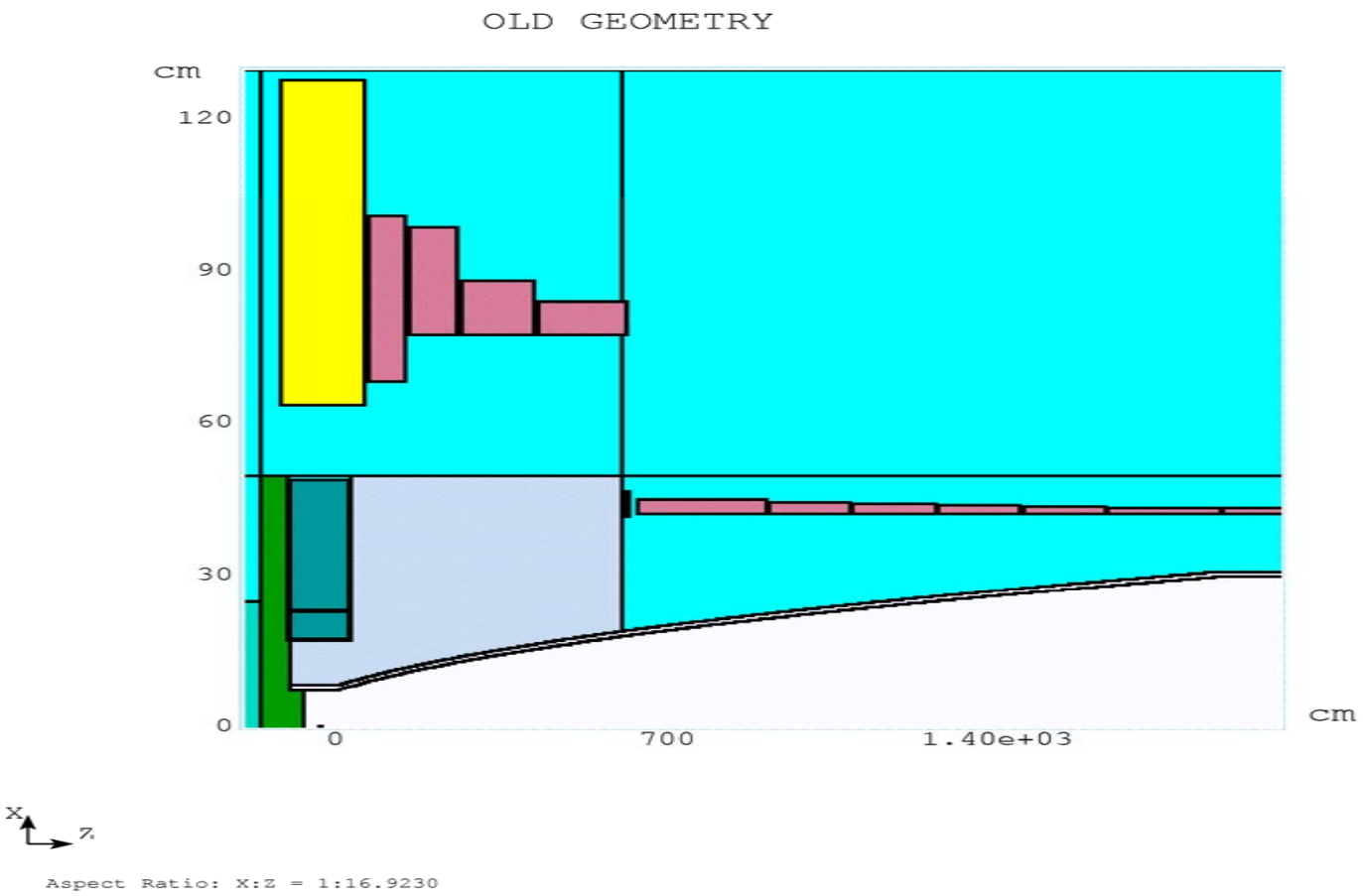
GAUSSIAN PROFILE: $\sigma_x=\sigma_y=0.12$ cm

E=8 GeV, 4MW proton beam

REPLACING THE RESISTIVE MAGNET WITH SHIELDING MATERIAL

also introducing a 20 MeV neutron energy cutoff.

STANDARD (OLD) SOLENOID GEOMETRY



SC#1 -120<z<57.8 cm R_{in}=63.3 cm R_{out}=127.8 cm

SC#2 67.8<z<140.7 cm R_{in}=68.6 cm R_{out}=101.1 cm

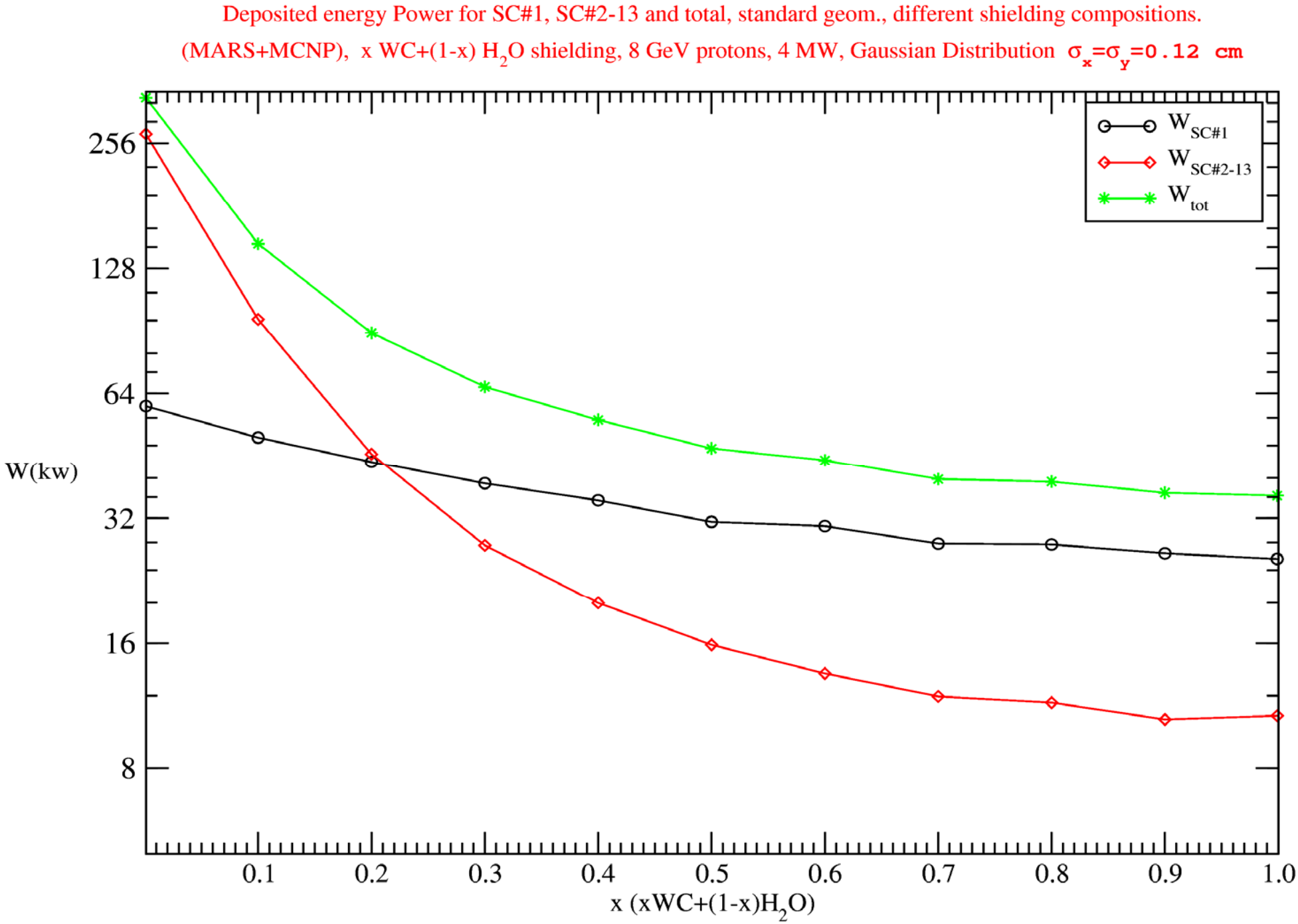
SC#6-13 632.5<z<218.7 cm R_{in}=42.2 cm R_{out}=45.1-->43.4 cm (TOTAL # SC=13)

Table 0.3: POWER OF DEPOSITED ENERGY IN KW, N_p=100,000 , STANDARD GEOMETRY,13 SC COILS, 2 SC groups:G1=1, G2=2-13 SOLENOID MATERIALS: SC#1-13=SCON (NiTi+Cu+..) SHIELDING 80% WC+20% H_2O (CASE a),WITH 20 MeV CUTOFF (CASE b) REPLACING RESISTIVE MAGNET (Cu) WITH 80% WC+20% H_2O SHIELDING MATERIAL (CASE c) AND ALSO WITH THE 20 MeV NEUTRON CUTOFF (CASE d) (10/18/2010)

	G1	%	G2	%	Total	%
a	27.69	–	11.54	–	39.23	–
b	13.09	-47.58	8.30	-29.90	21.39	-41.89
c	9.27	-66.52	9.80	-15.08	19.07	-51.39
d	4.41	-52.43	7.97	-18.67	12.38	-35.08

ENERGY DEPOSITED FOR DIFFERENT COMPOSITIONS OF THE SHIELDING (x WC+(1-x) H_2O)

	SHIELDING	ρ(g/cc)	G1	%	G2	%	Total	%
1	0.1% WC+99.9% H_2O	1.0148	59.75	–	269.25	–	329.00	–
2	10% WC+90% H_2O	2.48	50.15		96.50		146.65	
3	20% WC+80% H_2O	3.96	43.78		45.75		89.53	
4	30% WC+70% H_2O	5.44	38.86		27.56		66.41	
5	40% WC+60% H_2O	6.92	35.36		19.98		55.34	
6	50% WC+50% H_2O	8.4	31.38		15.85		47.22	
7	60% WC+40% H_2O	9.88	30.67		13.54		44.21	
8	70% WC+30% H_2O	11.36	27.84		11.94		39.78	
9	80% WC+20% H_2O	12.84	27.69		11.54		39.23	
10	90% WC+10% H_2O	14.32	26.37		10.52		36.89	
11	99.9% WC+0.1% H_2O	15.79	25.56		10.74		36.30	
1C	0.1% WC+99.9% H_2O	1.0148	31.90	–	221.70	–	253.60	–
2C	10% WC+90% H_2O	2.48	25.35		71.10		96.45	
3C	20% WC+80% H_2O	3.96	21.48		31.46		52.94	
4C	30% WC+70% H_2O	5.44	18.77		18.80		37.57	
5C	40% WC+60% H_2O	6.92	17.02		13.79		30.80	
6C	50% WC+50% H_2O	8.4	15.21		10.62		25.83	
7C	60% WC+40% H_2O	9.88	14.10		9.58		23.68	
8C	70% WC+30% H_2O	11.36	13.26		8.98		22.24	
9C	80% WC+20% H_2O	12.84	13.09		8.30		21.39	
10C	90% WC+10% H_2O	14.32	12.45		8.14		20.58	
11C	99.9% WC+0.1% H_2O	15.79	11.95		7.94		19.89	


Deposited energy Power for SC#1, SC#2-13 and total, standard geom., different shielding compositions.
(MARS+MCNP), x WC+(1-x) H2O shielding, 8 GeV protons, 4 MW, Gaussian Distribution σx=σy=0.12 cm
W(kw)
256
128
64
32
16
8
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
x (xWC+(1-x)H2O)
W SC#1
W SC#2-13
W tot

DEPOSITED ENERGY FOR DIFFERENT NEUTRON ENERGY CUTOFFS

	$E_n \geq E_i$(MeV)	SC#1	%	SC#2-13	%	Total	%
1	$1\ 10^{-11}$	37.94	–	12.25	–	50.19	–
2	$1\ 10^{-10}$	37.94	0	12.25	0	50.19	0
3	$1\ 10^{-9}$	38.20	+0.69	13.04	+6.45	51.24	+2.09
4	$1\ 10^{-8}$	37.00	-2.48	12.43	+1.47	49.43	-1.51
5	$1\ 10^{-7}$	33.89	-10.67	11.82	-3.51	45.75	-8.84
6	$1\ 10^{-6}$	31.64	-16.60	11.60	-5.31	43.24	-13.85
7	$1\ 10^{-5}$	30.59	-19.37	11.28	-7.92	41.87	-16.58
8	$1\ 10^{-4}$	29.50	-22.25	11.57	-5.51	41.06	-18.19
9	$1\ 10^{-3}$	29.00	-23.56	11.03	-9.96	40.03	-20.24
10	$1\ 10^{-2}$	28.47	-24.96	11.17	-8.81	39.63	-21.04
11*	$1\ 10^{-1}$	27.69	-27.02	11.54	-5.80	39.23	-21.84
12	$1\ 10^{0}$	26.73	-29.55	11.42	-6.78	38.15	-23.99
13	$1\ 10^{+1}$	20.51	-45.94	9.97	-18.61	30.48	-39.27
14*	$2\ 10^{+1}$	13.09	-65.50	8.30	-32.24	21.39	-57.38
15	$5\ 10^{+1}$	7.78	-79.49	7.39	-39.67	15.17	-69.77
16	$10\ 10^{+1}$	4.30	-88.67	6.85	-44.08	11.15	-77.78
17	$15\ 10^{+1}$	2.43	-90.27	6.01	-49.24	8.44	-83.18
18	$30\ 10^{+1}$	0.50	-98.68	4.90	-59.98	5.40	-89.24

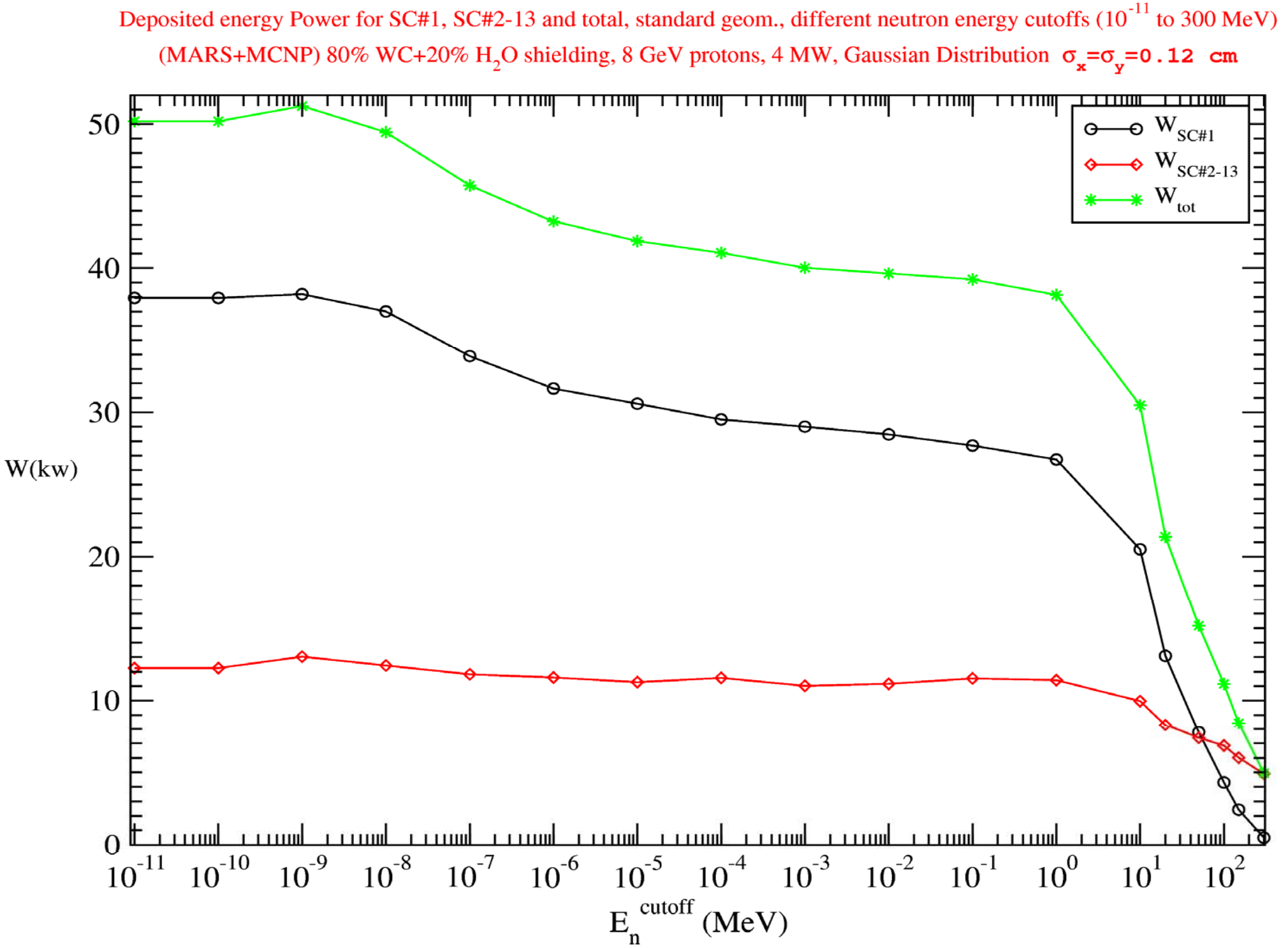

Deposited energy Power for SC#1, SC#2-13 and total, standard geom., different neutron energy cutoffs (10^{-11} to 300 MeV)
(MARS+MCNP) 80% WC+20% H_2O shielding, 8 GeV protons, 4 MW, Gaussian Distribution $\sigma_x=\sigma_y=0.12$ cm
$W_{SC\#1}$
$W_{SC\#2-13}$
W_{tot}
W(kw)
0
10
20
30
40
50
10^{-11} 10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2}
E_n^{cutoff} (MeV)

Table 0.7: MARS+MCNP, STANDARD GEOMETRY, 8 GeV, 4 MW, GAUSSIAN ($\sigma_x = \sigma_y$ =0.12 cm), 80% WC+20% H_2O SHIELDING, POWER OF DEPOSITED ENERGY IN KW, INITIALIZING MARS WITH DIFFERENT SEEDS(NOTICE:last Case 20* is the seed used throughout the rest of our studies. (10/(8,13)/2010)

	SEED(8 DIG.)	SC#1	SC#2-13	Total
1	23765224	27.56	11.28	38.83
2	35765224	27.49	11.31	38.80
3	77225426	27.76	11.06	38.82
4	66666666	27.34	11.19	38.53
5	12345671	27.91	11.20	39.11
6	52255524	27.27	11.43	38.70
7	23445625	27.58	11.38	38.96
8	36264424	27.11	10.87	37.97
9	73275327	27.11	11.52	38.63
10	66265556	28.00	10.93	38.93
11	61215253	27.45	11.09	38.54
12	61225355	27.28	11.44	38.72
13	46461122	27.79	11.31	39.10
14	11235353	27.88	11.35	39.23
15	23215151	27.63	11.06	38.69
16	11245454	27.89	11.36	39.23
17	23235353	27.35	10.81	38.16
18	52245454	27.63	11.68	39.31
19	62265555	27.98	11.10	39.08
20*	55265522	27.64	11.54	39.23
–	MIN	27.11	10.81	37.97
–	MAX	28.00	11.68	39.31
–	AVERAGE	27.58	11.25	38.83
–	σ(Deviat.)	0.272	0.226	0.347