Technical data for the NCSX Conceptual Design may be accessed in the following files:

- Plots of current waveforms, coil temperatures, and power and energy demands for reference scenarios
    - Initial ohmic
    - 1.7T ohmic
    - 1.7T high beta
    - 2T high beta
    - 350kA ohmic
- Winding pack geometry
    - Modular coils
    - TF
    - PF
- Current waveforms for reference scenarios
- Coil temperatures for reference scenarios
- Power and energy requirements for reference scenarios
- Power supply requirements by phase of operation
- Cryogenic heat loads

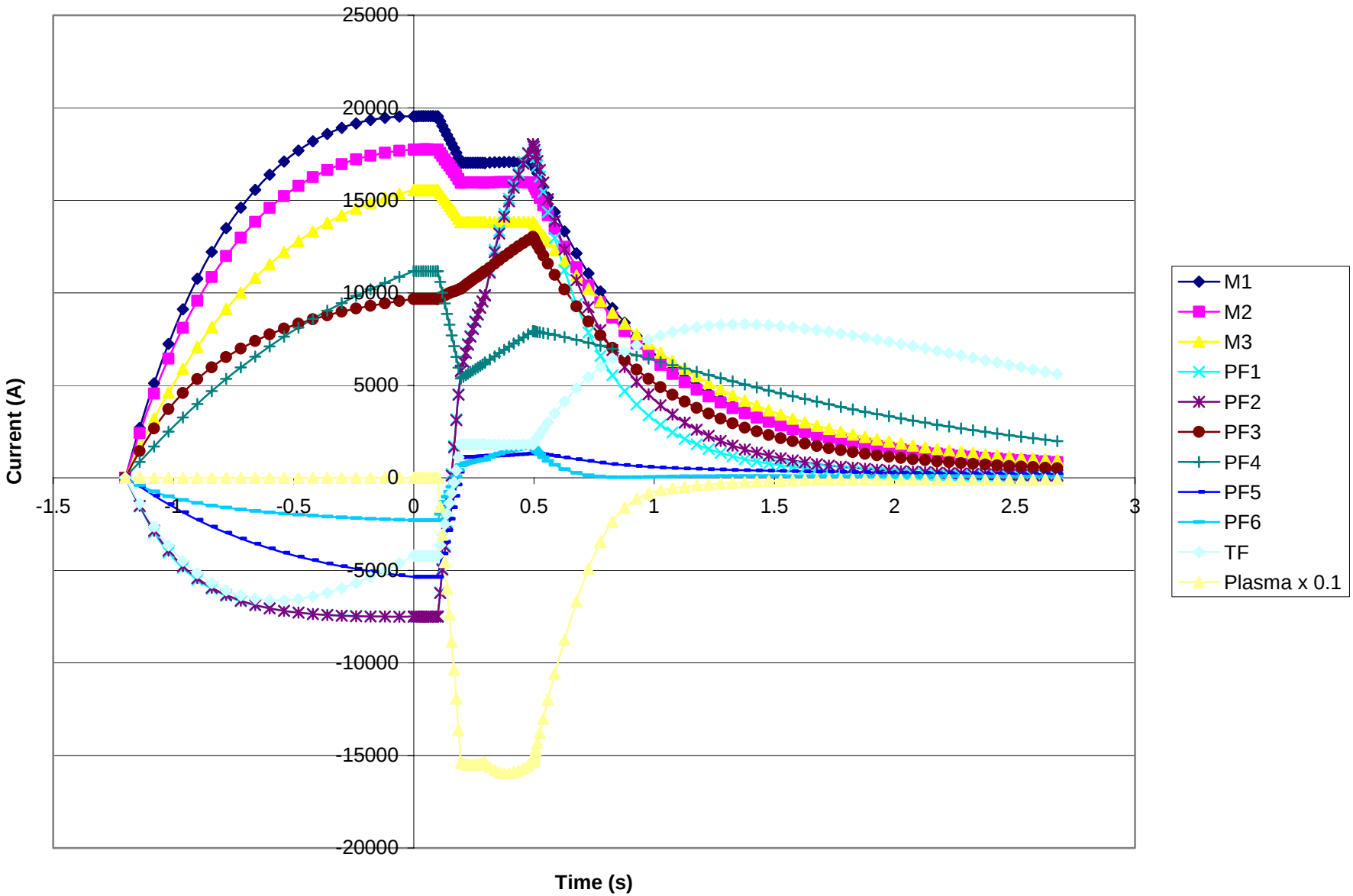
Current, temperature, power, and energy plots for NCSX scenarios

Coil Set C01R00

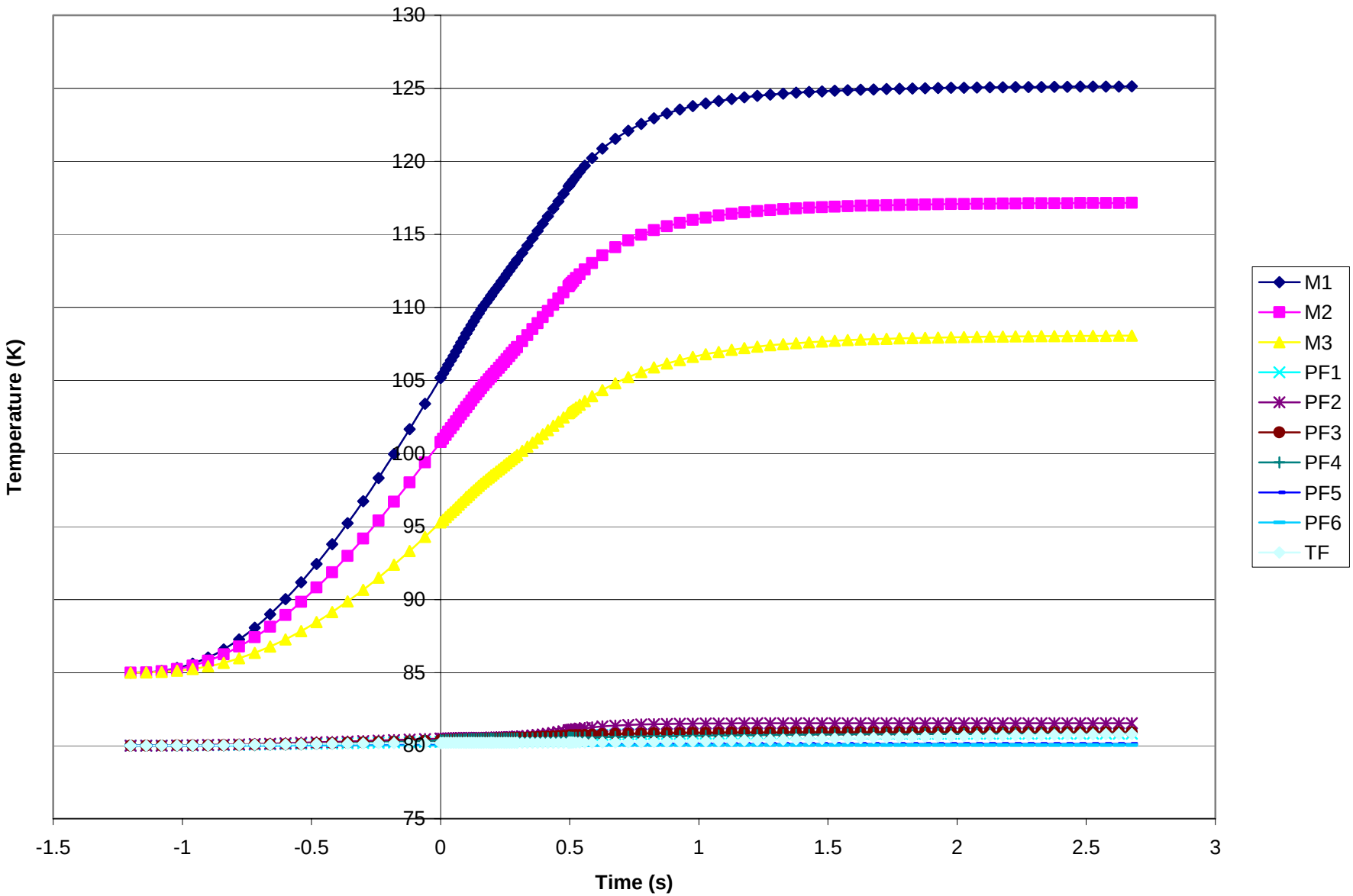
Scenario set K

April 17, 2002

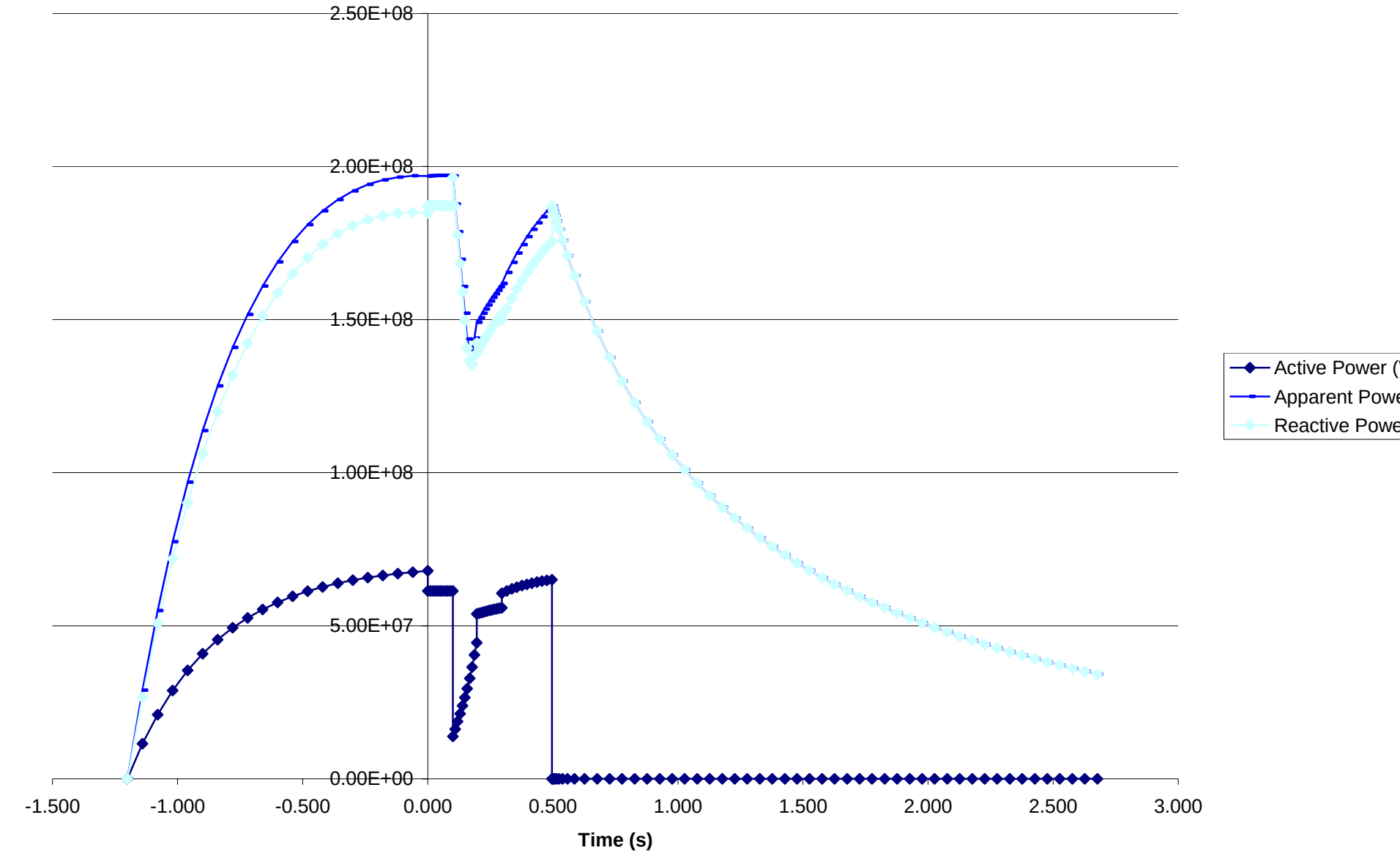
Initial ohmic scenario currents



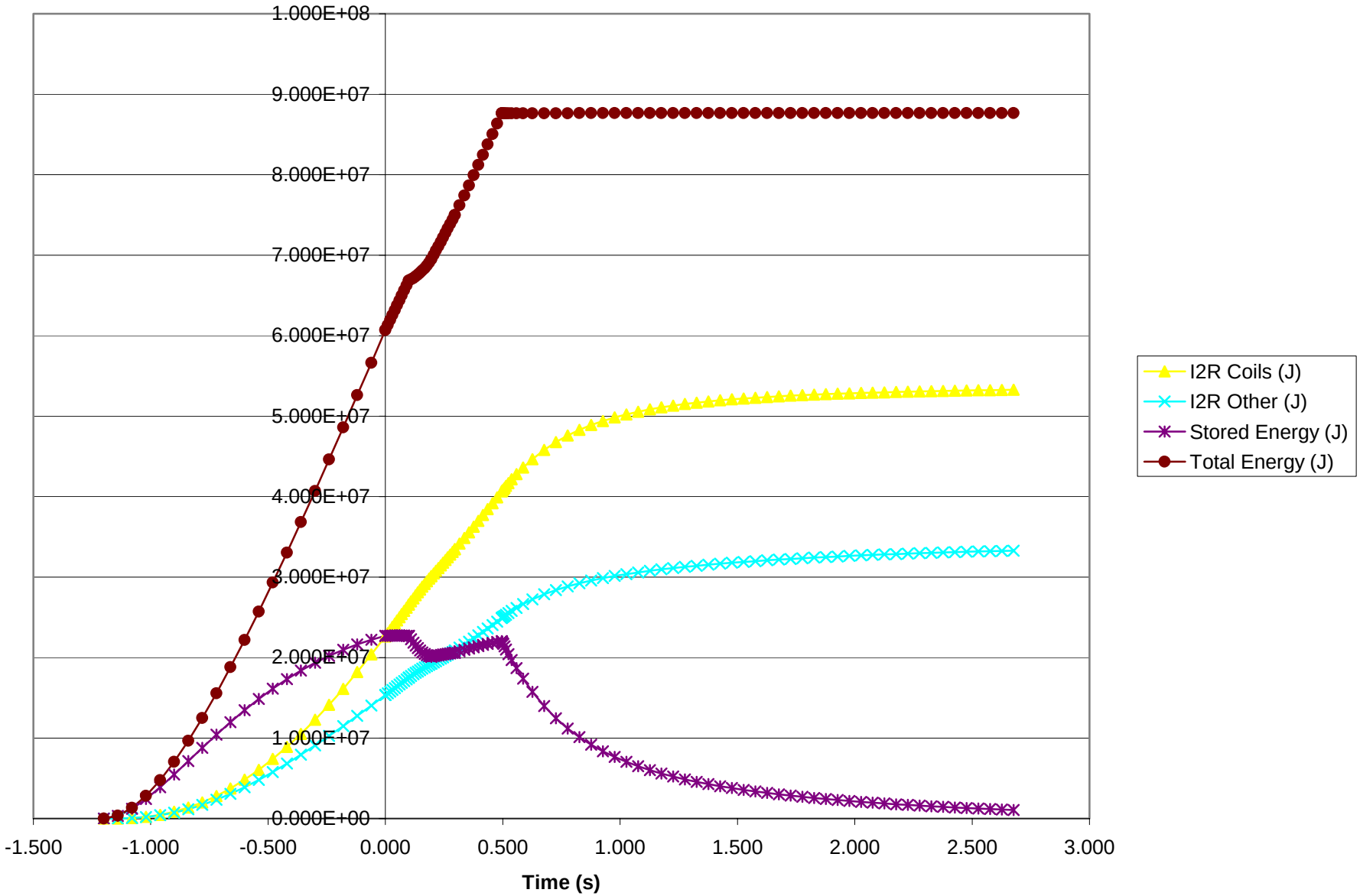
Initial ohmic scenario temperatures



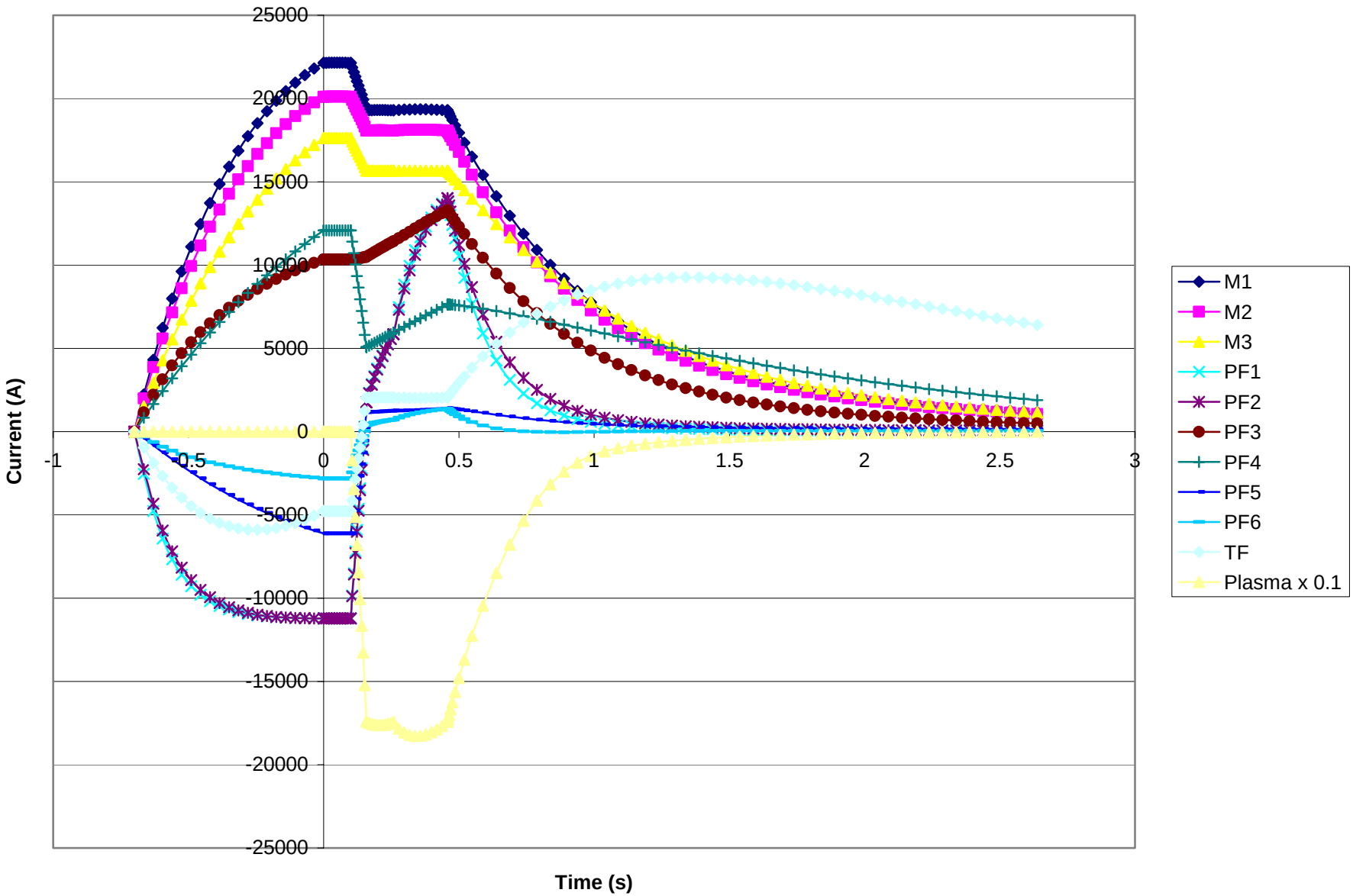
Initial ohmic scenario power requirements



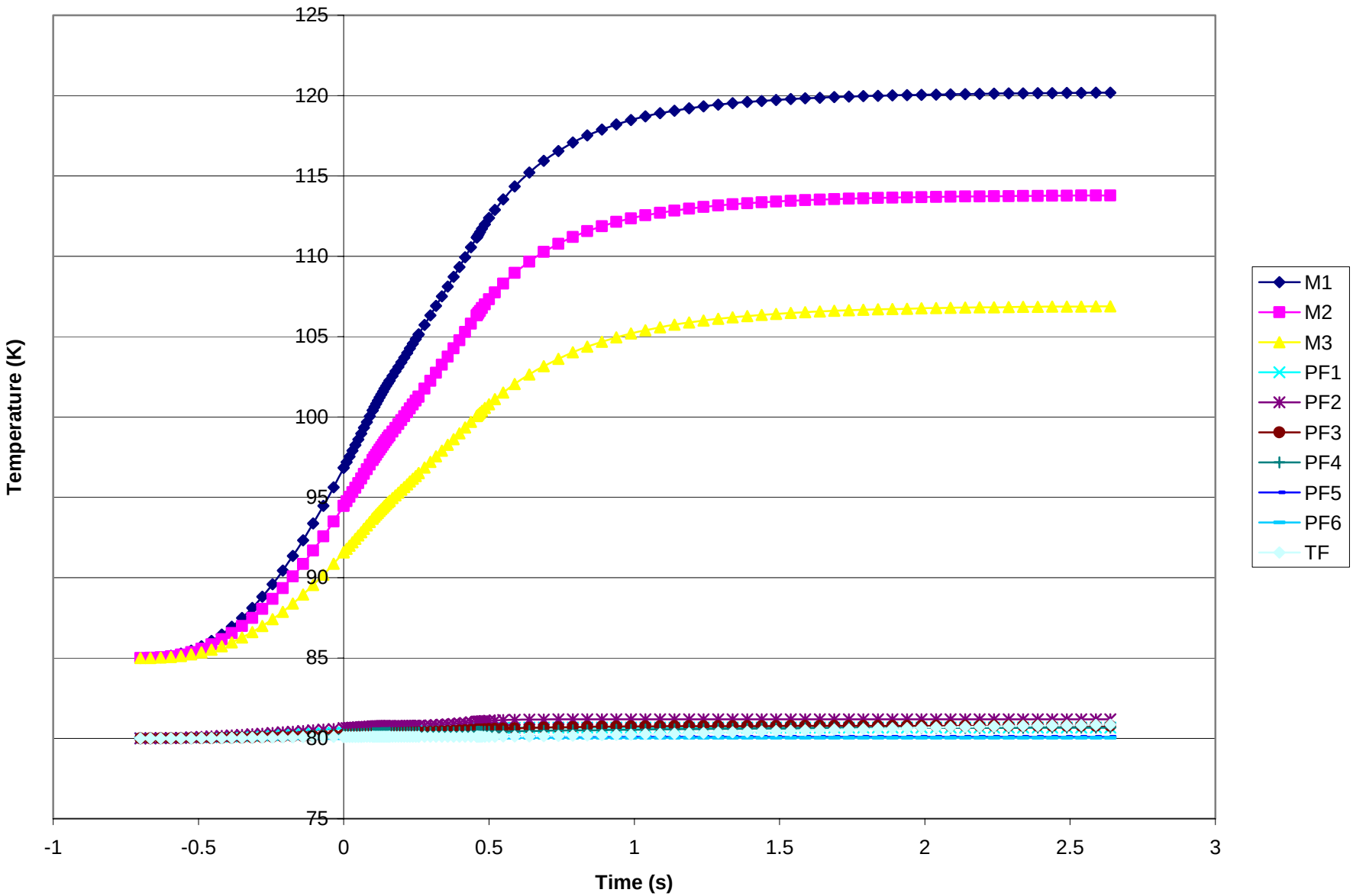
Initial ohmic scenario energy requirements



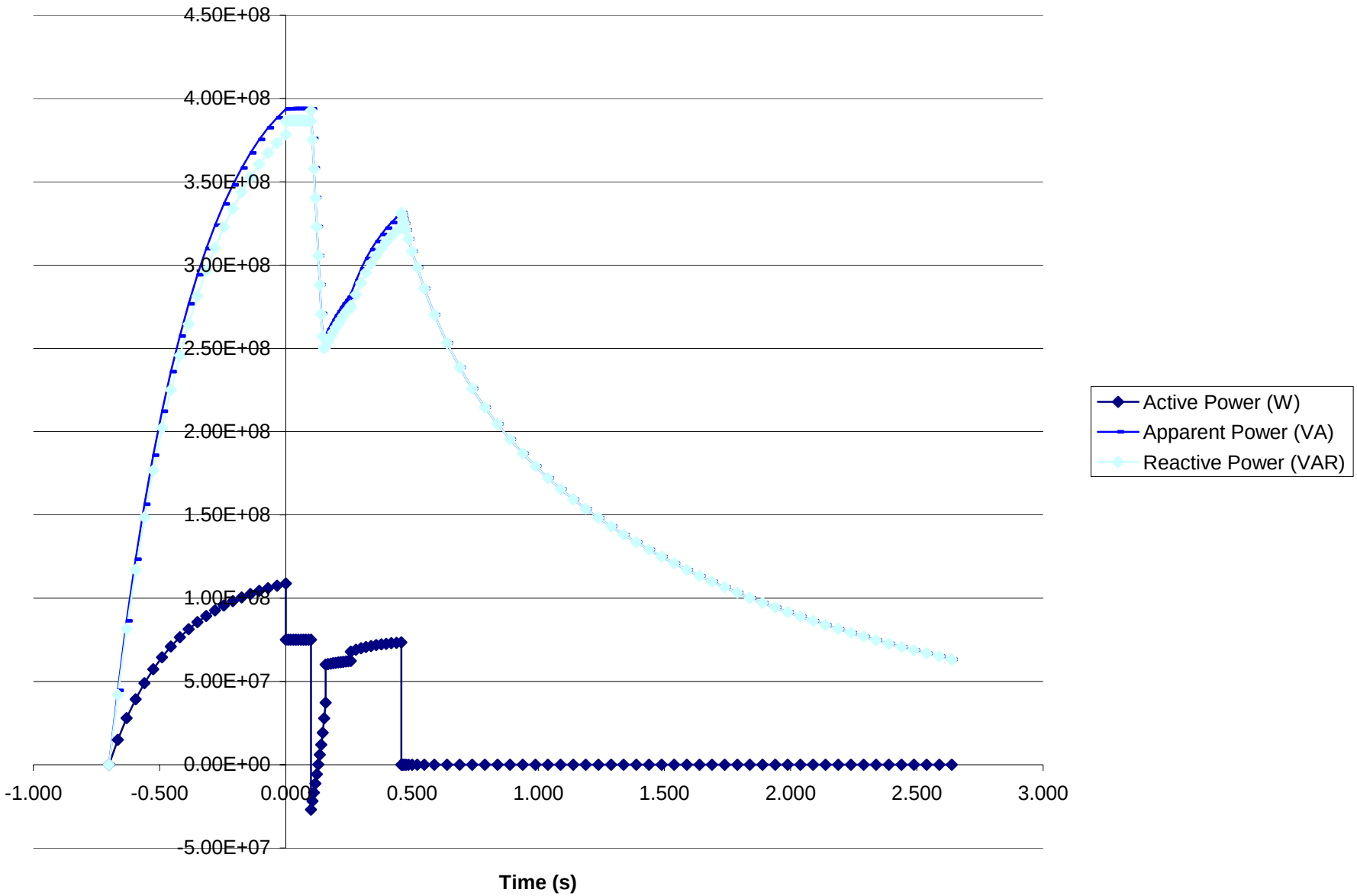
1.7T ohmic scenario currents



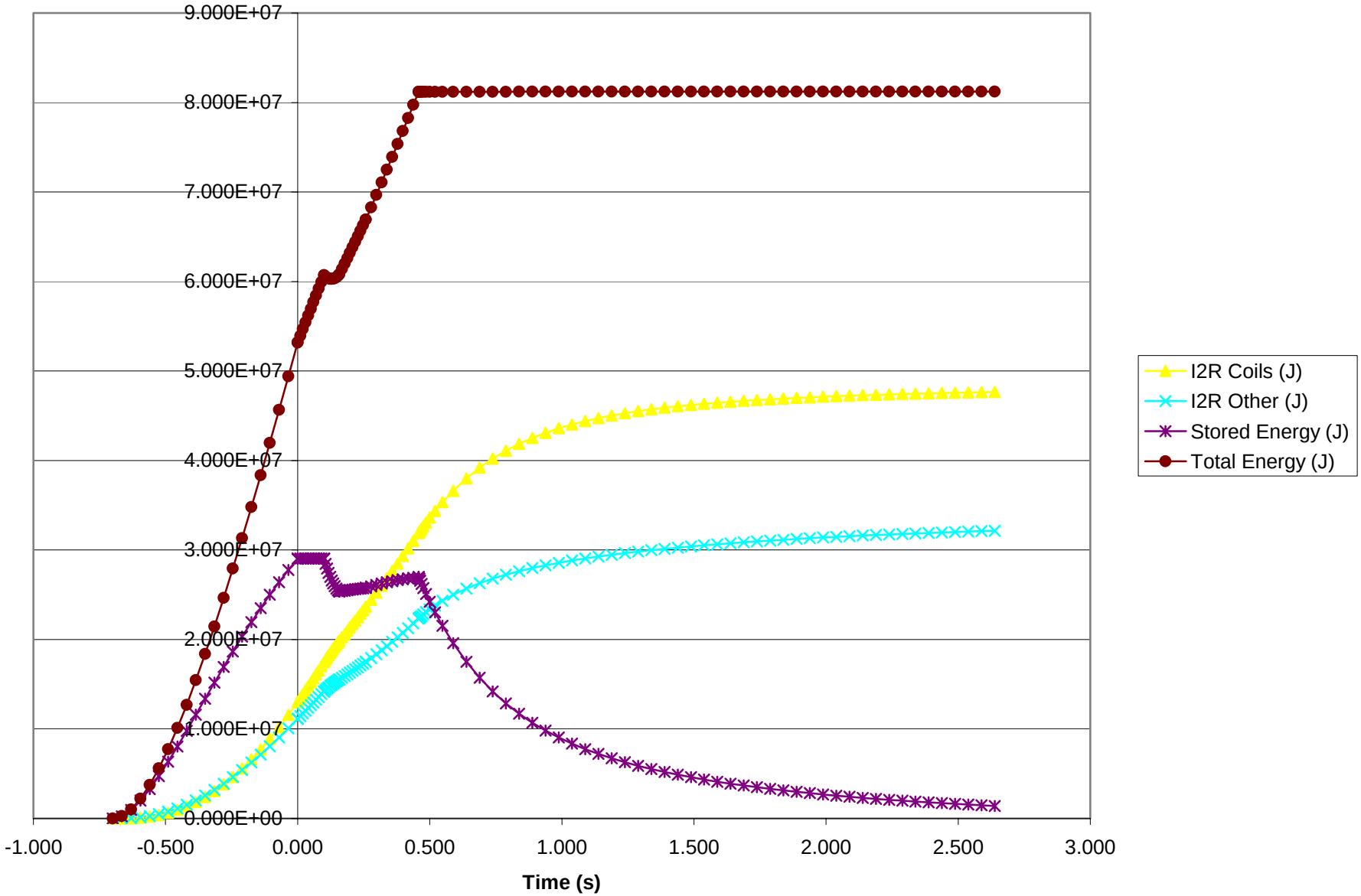
1.7T ohmic scenario temperatures



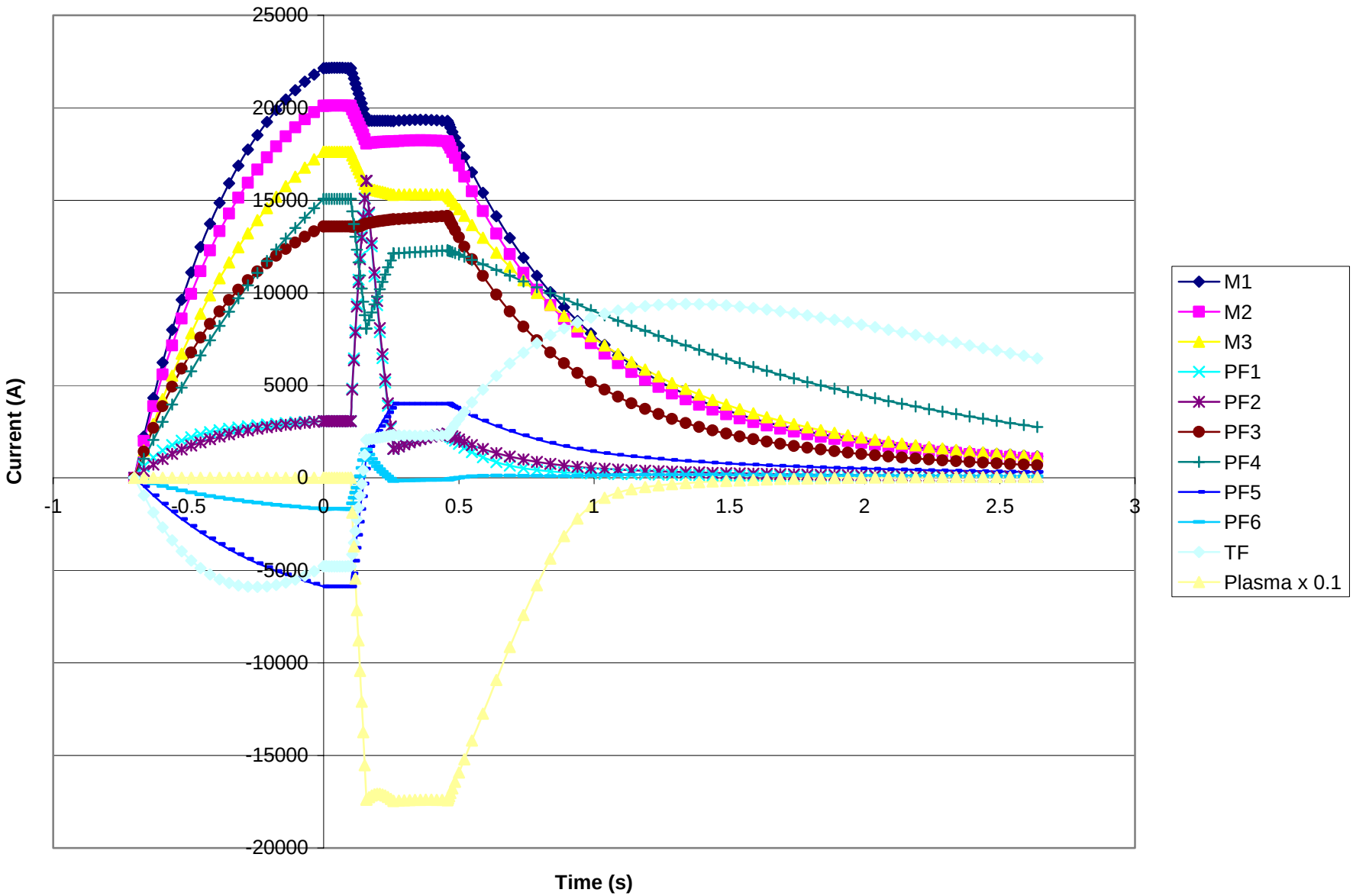
1.7T ohmic scenario power requirements



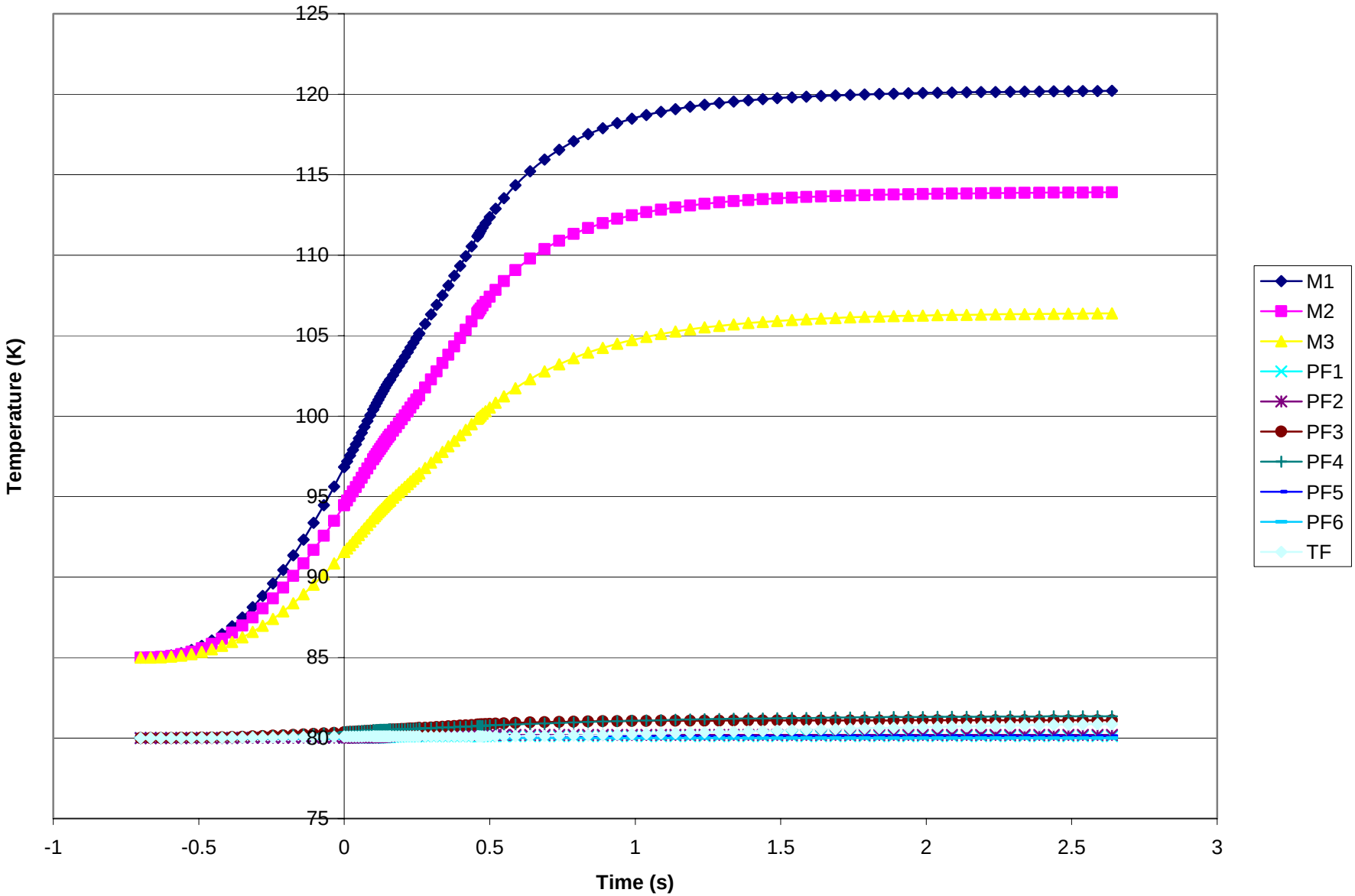
1.7T ohmic scenario energy requirements



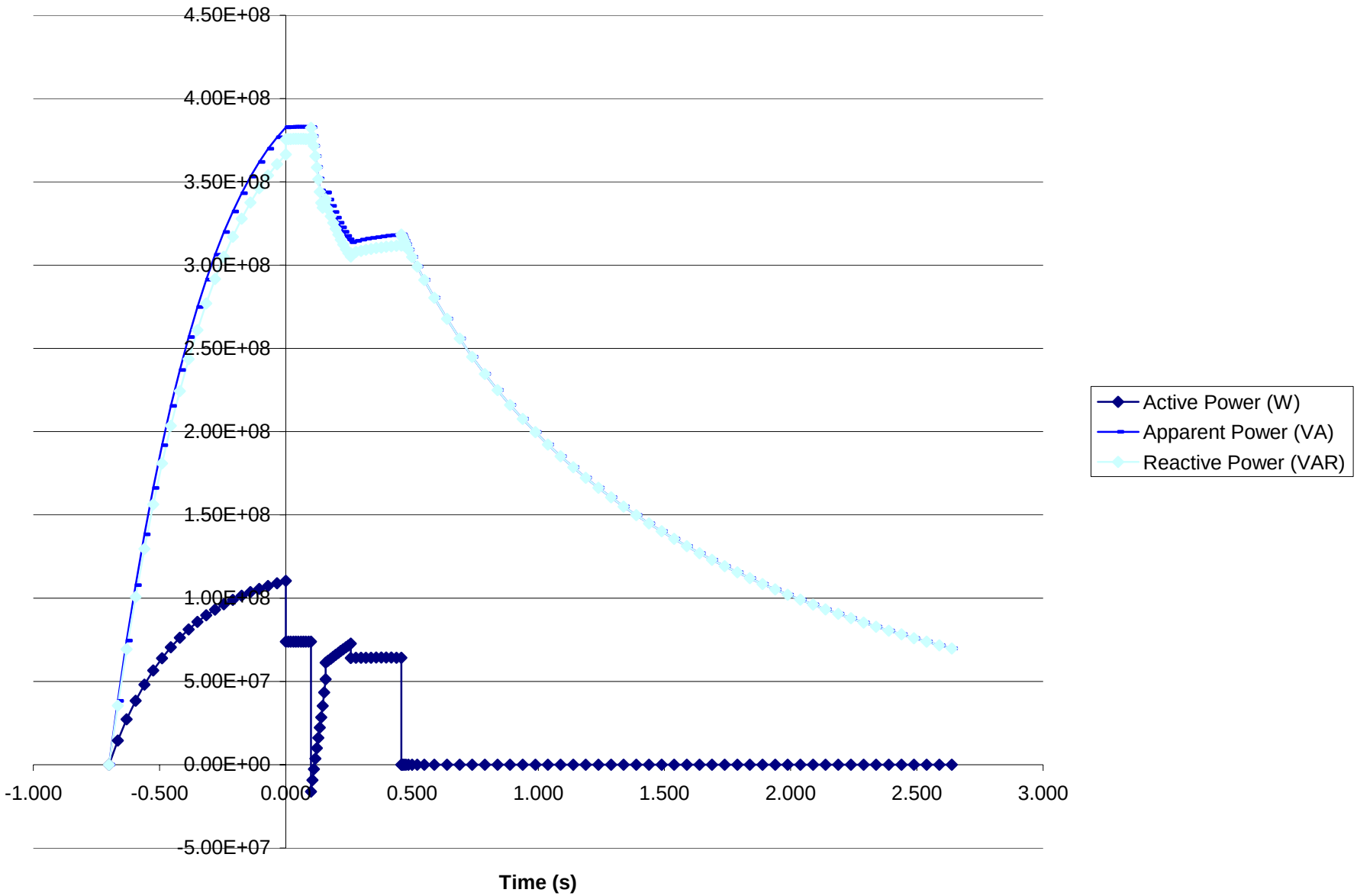
1.7T high beta scenario currents



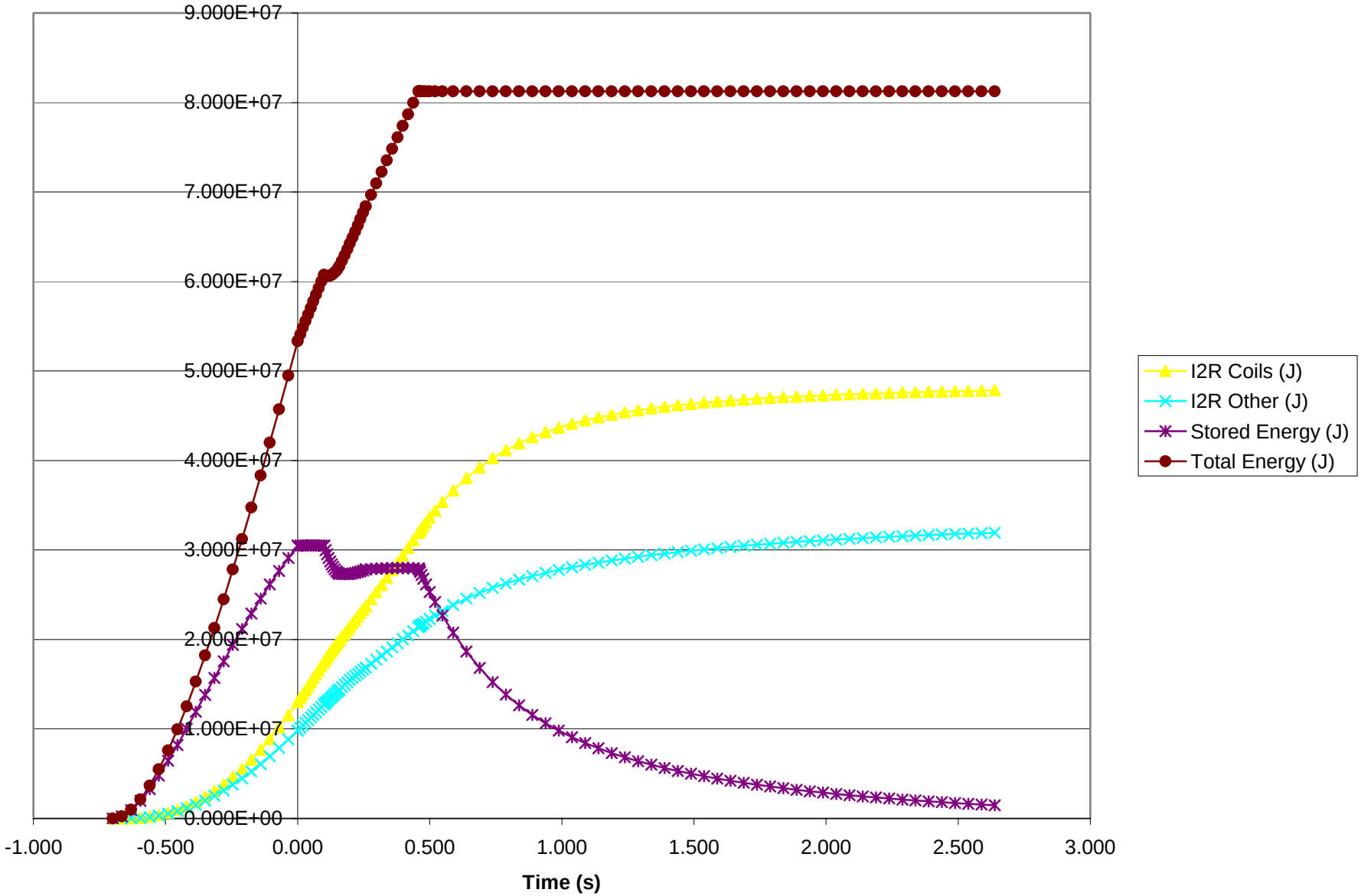
1.7T high beta scenario temperatures



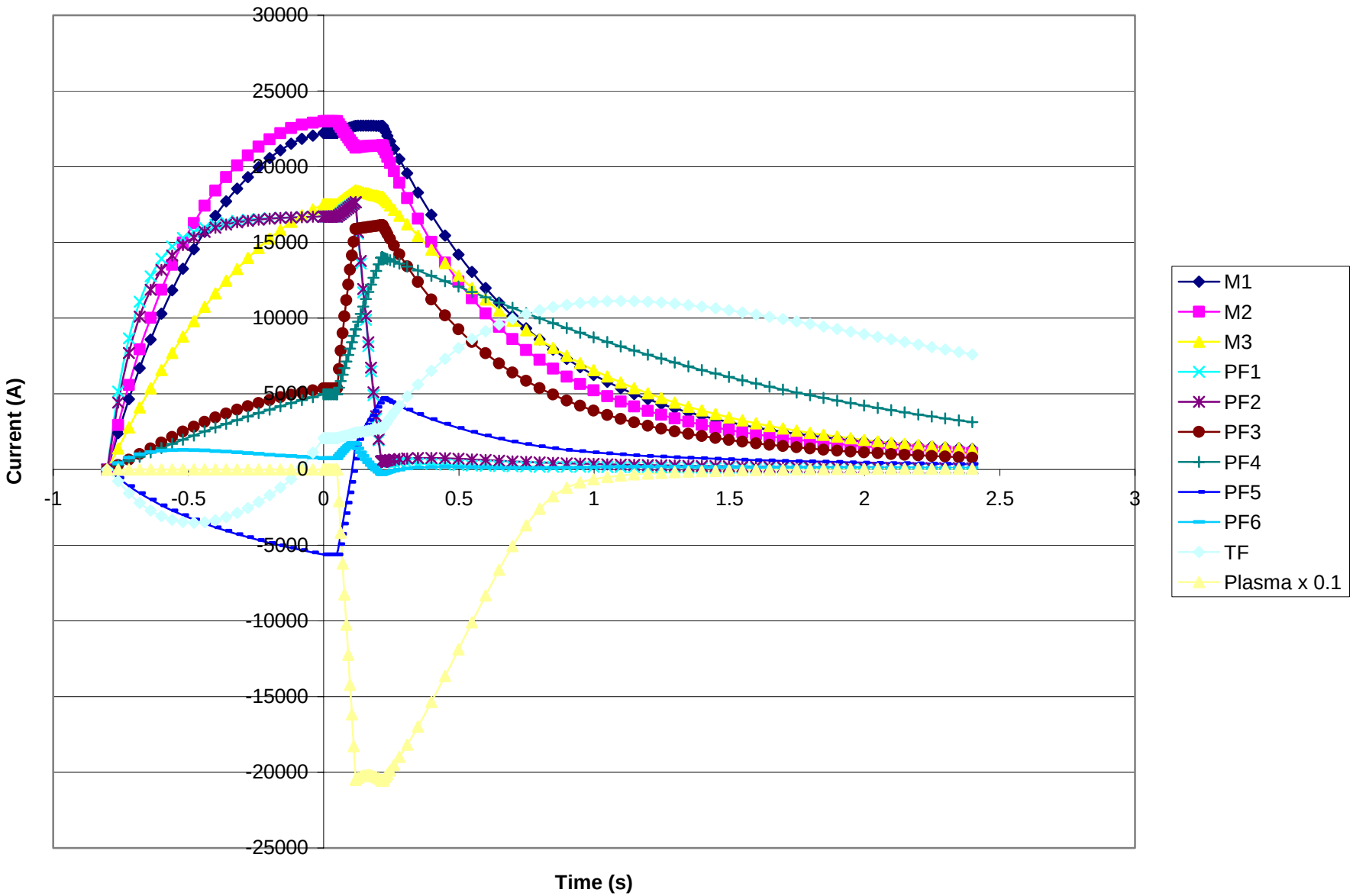
1.7T high beta scenario power requirements



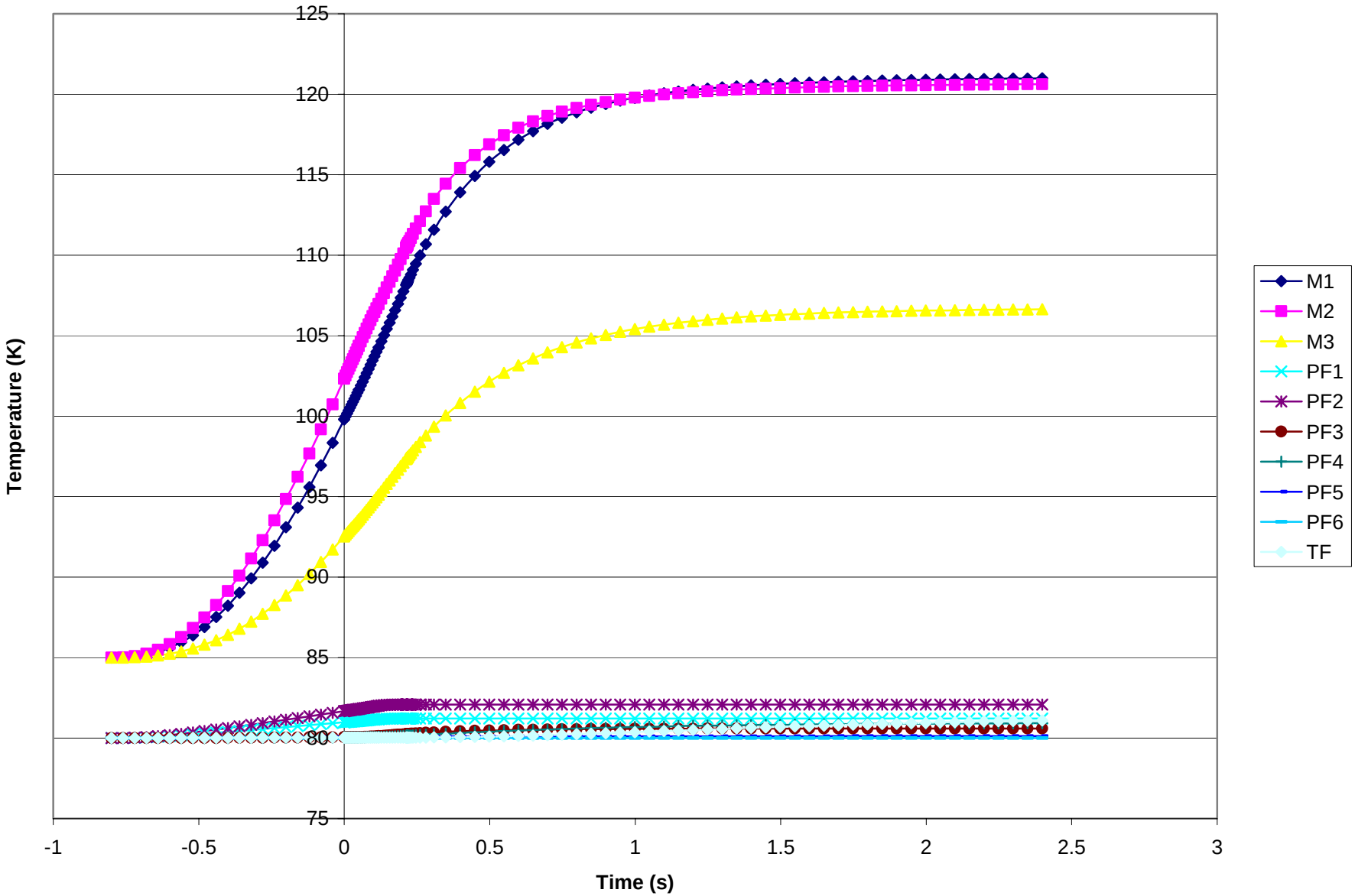
1.7T high beta scenario energy requirements



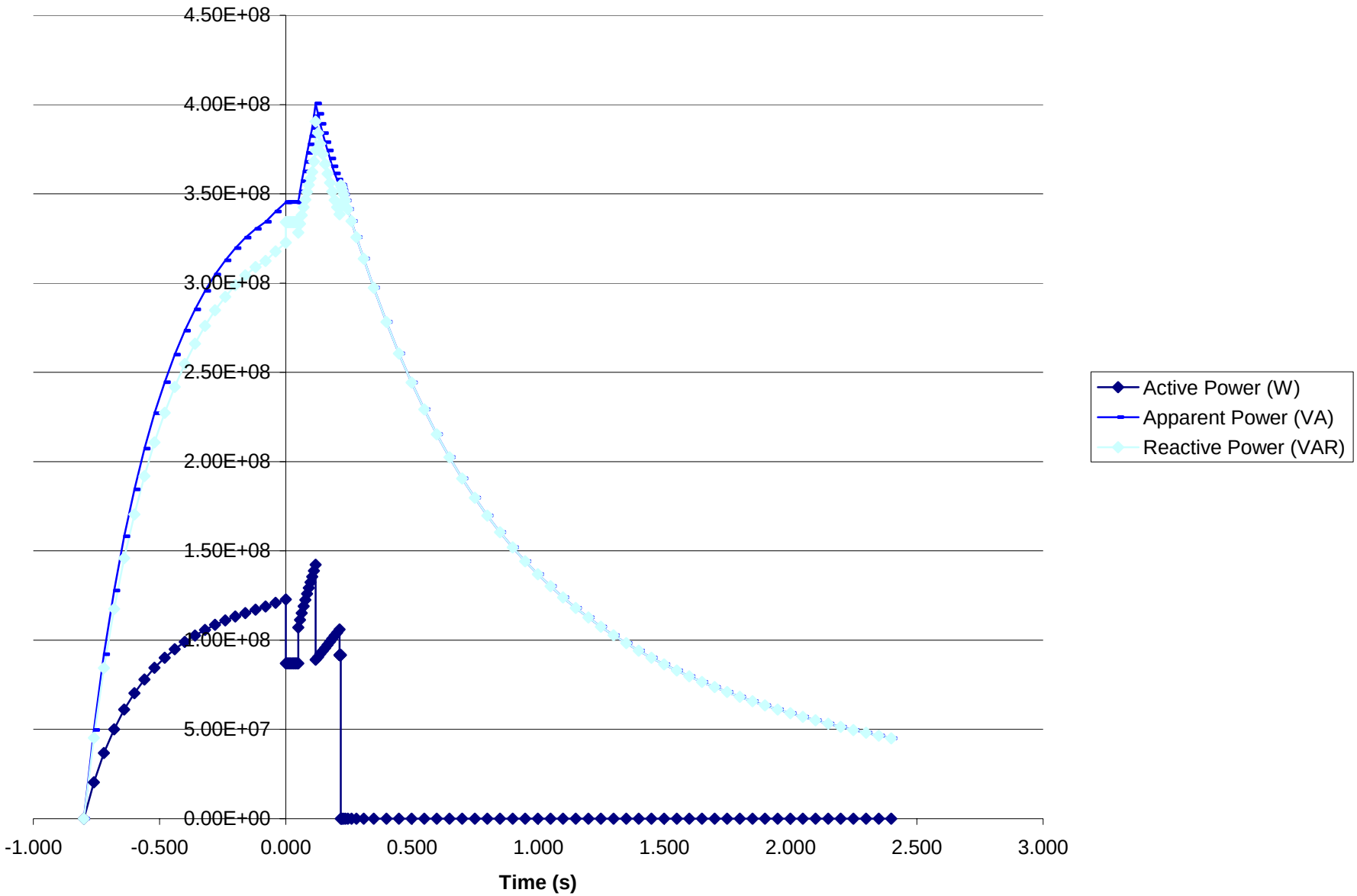
2T high beta scenario currents



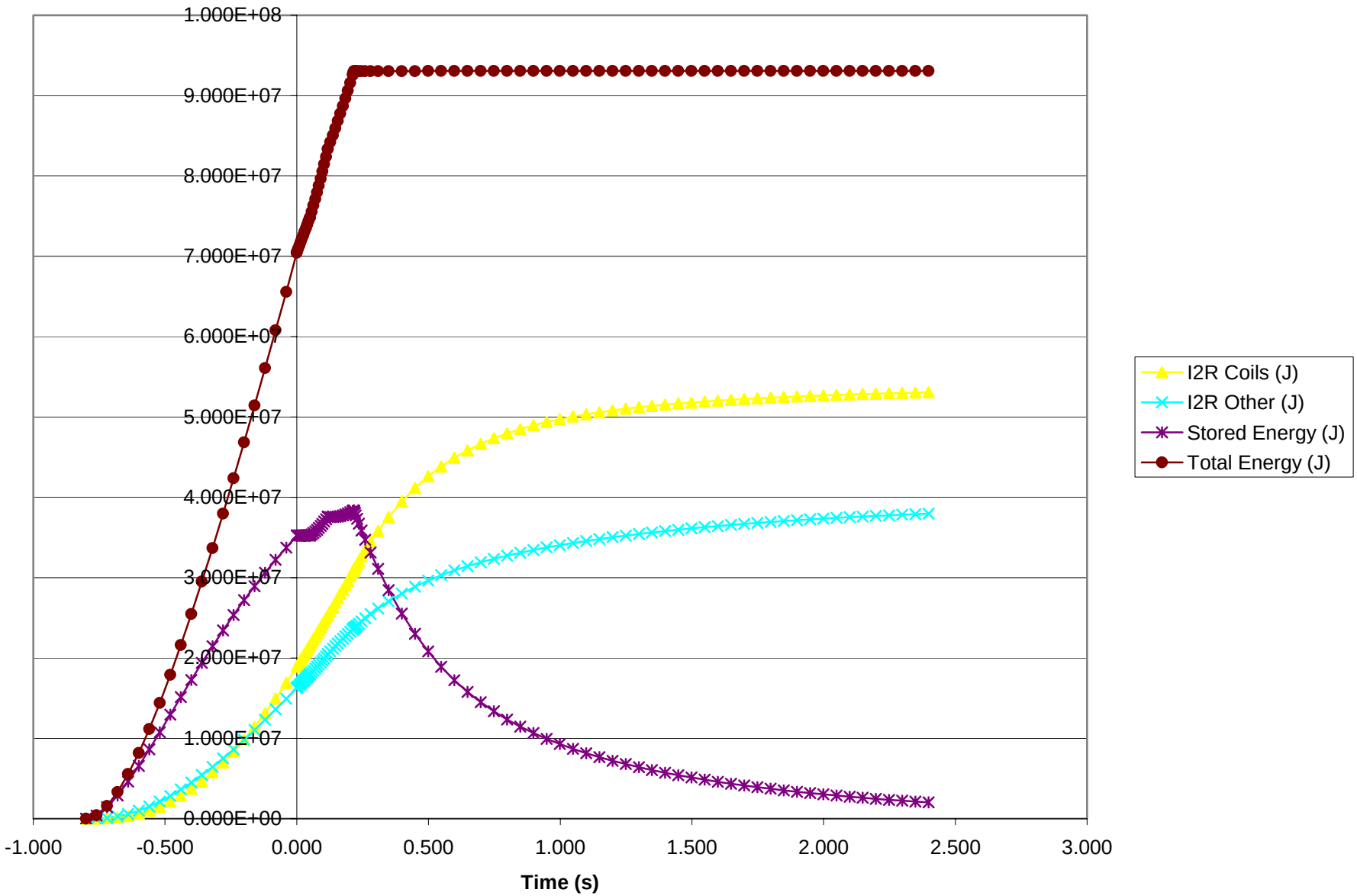
2T high beta scenario temperatures



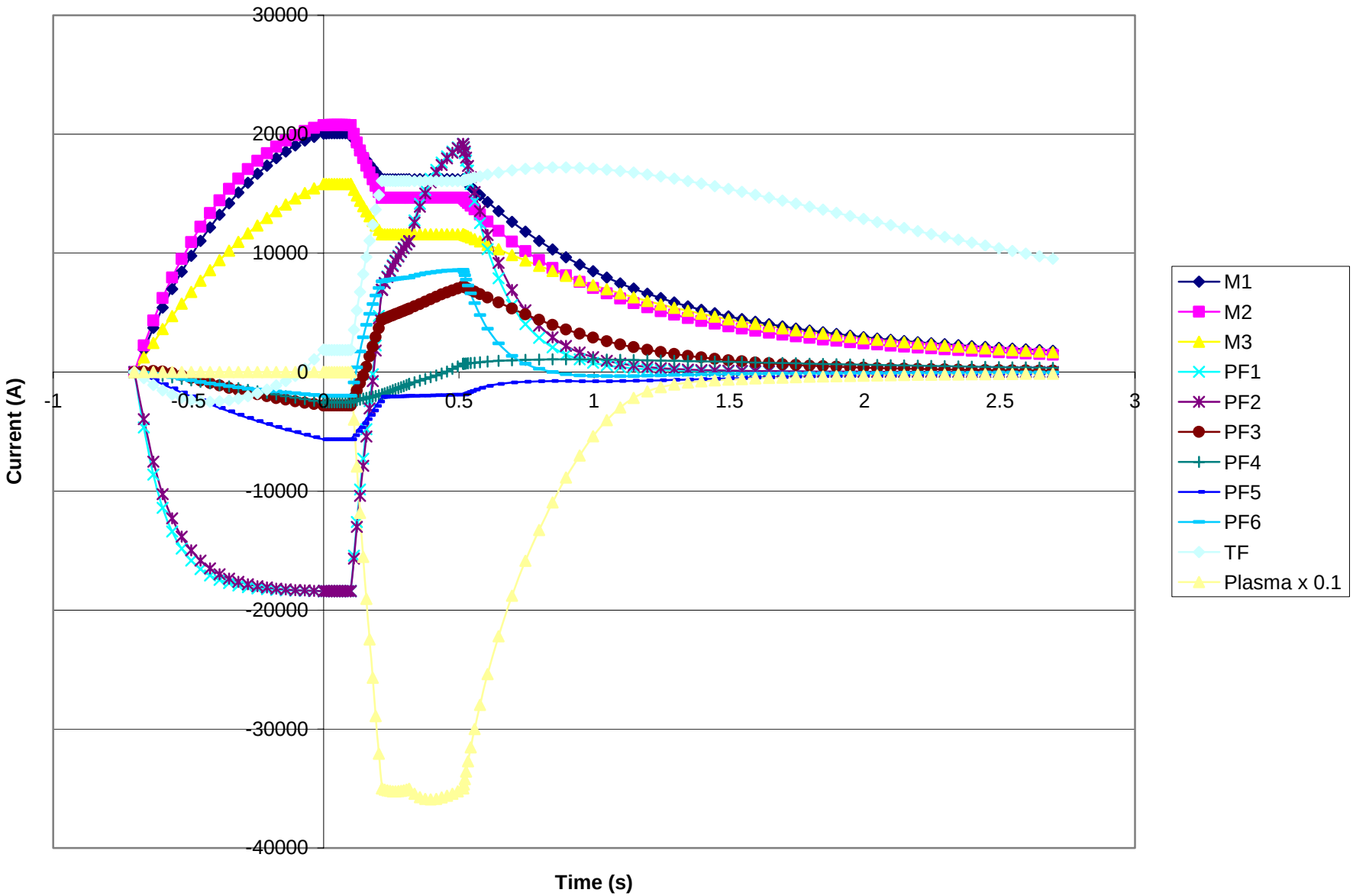
2T high beta scenario power requirements



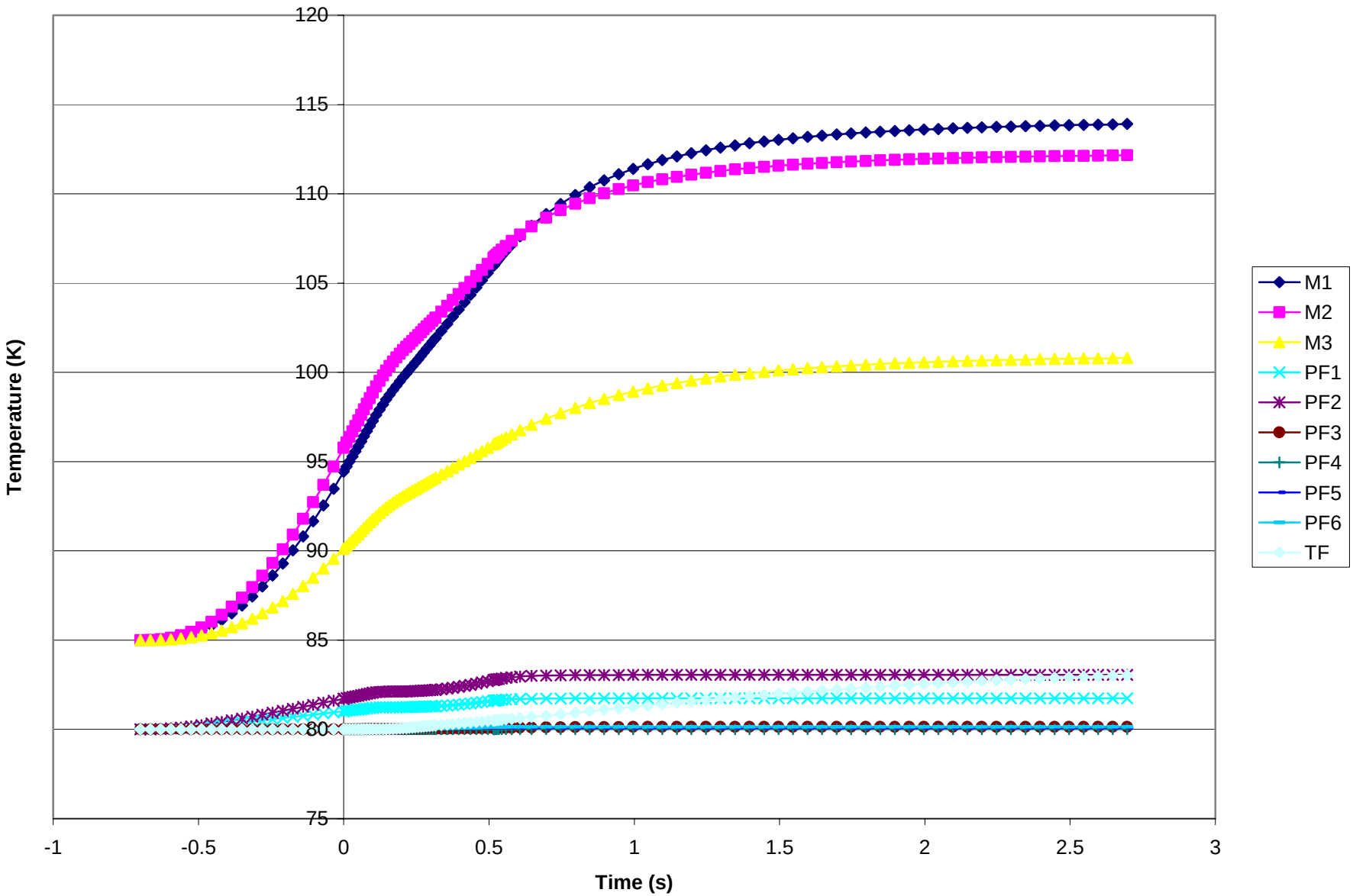
2T high beta scenario energy requirements



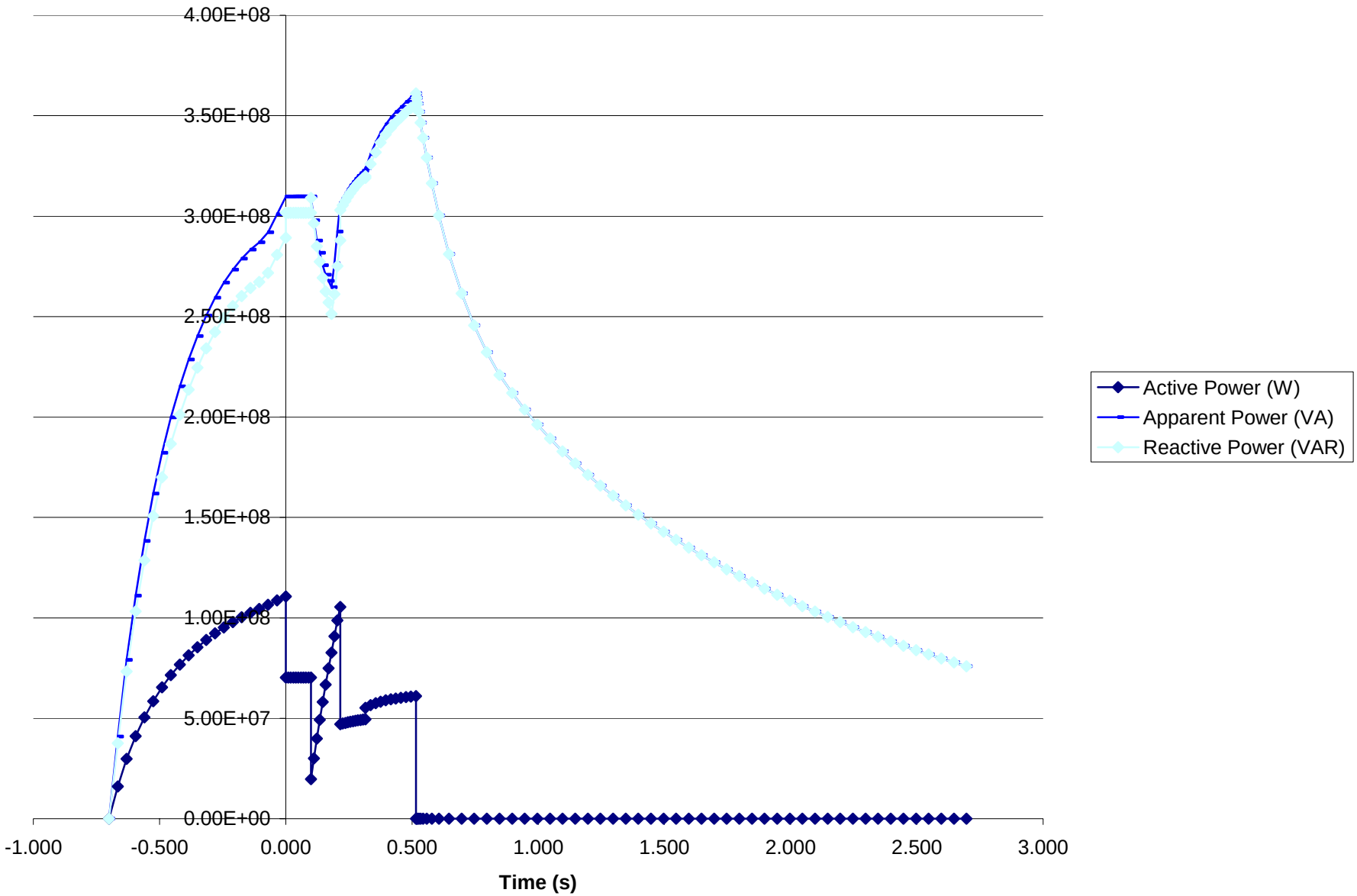
350kA ohmic scenario currents



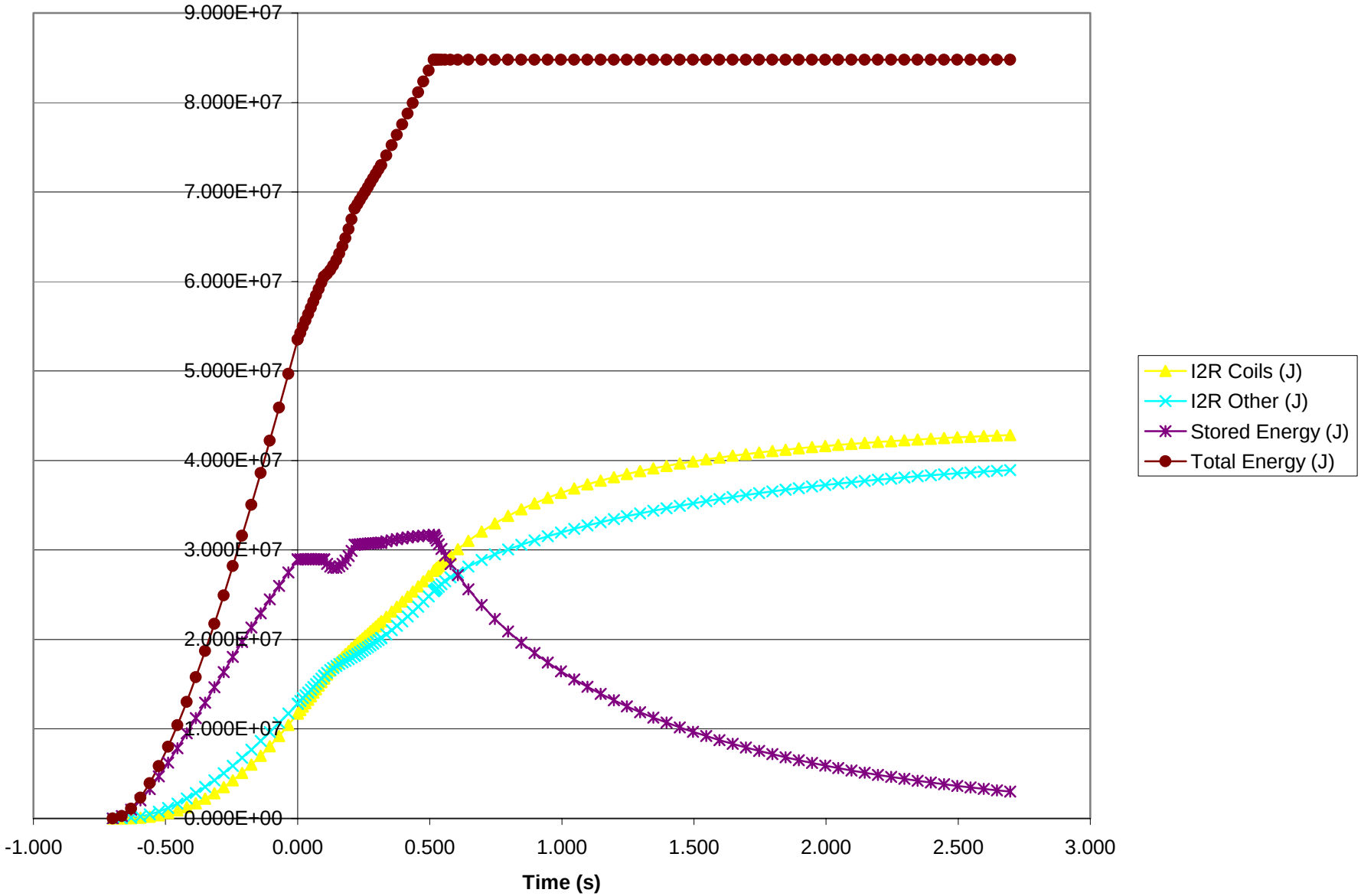
350kA ohmic scenario temperatures



350kA ohmic scenario power requirements



350kA ohmic scenario energy requirements



Combined coil geometry

Modular coil geometry

Ref. modular coil designation m45r00

	M1	M2	M3
Length_m	7.351	7.13	6.537
NumberFilaments	400	400	400
Vmid	0.109	0.281	0.43
NumberCoils	6	6	6
NumWP	2	2	2
BundleHeight_mm	120	120	120
BundleWidth_mm	40	40	40
BundleArea_mm2	4800	4800	4800
BundleArea_m2	0.0048	0.0048	0.0048
EquivRadius_m	0.055279064	0.05527906	0.05527906
GroundWrap_mm	0.762	0.762	0.762
TurnInsulation_mm	0.762	0.762	0.762
InternalSeptum_mm	2.16	2.16	2.16
TurnsHigh	9	9	9
Turns	36	36	36
	864	864	864
ConductorLengthPerDP_m	132	128	118
ConductorHeight_mm	11.64	11.64	11.64
ConductorWidth_mm	16.634	16.634	16.634
ConductorArea_mm2	193.61976	193.61976	193.61976
CopperVolumeFraction	0.785	0.785	0.785
Area correction	-5.520%	-5.520%	-5.520%
CopperArea_mm2	143.6015802	143.60158	143.60158
Length correction	5.843%	5.843%	5.843%
Resistance correction for helical current path	12.03%	12.03%	12.03%
GeometricResistance_m-1	1.17E+07	1.14E+07	1.04E+07
Tstart_K	85	85	85
Resistivity_ohm-m	2.36E-09	2.36E-09	2.36E-09
InitialResistance_ohms	2.76E-02	2.67E-02	2.45E-02

MC insulation worksheet

75	V/mil
4000	V
2000	V
26.6666667	mils
30	mils
0.762	mm
6	coils
166.666667	V
1.11111111	mils
30	mils
0.762	mm

TF coil geometry

Reference TF coil designation tf01r00

	TF1	TF2	TF3	
Length_m	8.657			
NumberFilaments	100			
Vmid	0.083	0.25	0.417	
NumberCoils	6	6	6	18
TurnsHigh	3			
TurnsWide	4			
Turns	12			
	194			
ConductorLengthPerDP_m	52			
BundleHeight_mm	87.096			
BundleWidth_mm	99.906			
BundleArea_mm2	8701.412976			
BundleArea_m2	0.008701413			
EquivRadius_m	0.074427761			
GroundWrap_mm	0.762			
TurnInsulation_mm	0.762			
PancakeInsulation_mm	0.762			
ConductorHeight_mm	**27**			
ConductorWidth_mm	**22.5**			
CornerRadius_mm	**2.5**			
CornerArea_mm2	5.365045915			
CoolingHoleDia_mm	**13.5**			
CoolingArea_mm2	143.1388153			
ConductorArea_mm2	458.9961388			
FillFactor	1			
CopperArea_mm2	458.9961388			
Tstart_K	80			
Resistivity_ohm-m	1.99E-09			
GeometricResistance_m-1	4.07E+06			
InitialResistance_ohms	8.10E-03			
Required flexibility_T	0.3			
Current per turn for flexibility_kA	10			
Max current in reference scenario_kA	14			

TF insulation worksheet	
75	V/mil
4000	V
2000	V
26.6666667	mils
30	mils
0.762	mm
6	coils
111.111111	V
0.74074074	mils
30	mils
0.762	mm

PF coil geometry

Reference PF coil designation pf01r00

	PF1	PF2	PF3	PF4	PF5	PF6
Length_m	1.367	1.367	2.191	2.191	7.538	15.581
NumberFilaments	12	12	21	21	75	153
NumberCoils	2	2	2	2	2	2
Rpf	0.220	0.220	0.270	0.590	2.130	2.700
Zpf	0.225	0.675	1.240	1.580	1.470	0.970
Length_m	1.382300768	1.38230077	1.69646003	3.70707933	13.3831847	16.9646003
TurnsHigh	14	17	14	10	6	4
TurnsWide	4	4	8	10	4	2
Turns	56	68	112	100	24	8
ConductorLengthPerDP_m	38	46	61	44	90	125
	1.34	1.63	2.35	1.90	0.19	0.09
	1.34	1.63	0.61	0.50	0.01	0.02
	0	0	1739	1397	182	73
BundleHeight_mm	**402.384**	**402.956**	**402.384**	**288.288**	**174.192**	**117.144**
BundleWidth_mm	**101.43**	**101.43**	**200.574**	**250.146**	**101.43**	**51.858**
BundleGap_mm	48	47	162			
BundleArea_mm2	40813.80912	40871.8271	80707.7684	72114.09	17668.2946	6074.85355
BundleArea_m2	0.040813809	0.04087183	0.08070777	0.07211409	0.01766829	0.00607485
EquivRadius_m	0.161192053	0.16130658	0.22667192	0.21426445	0.10605652	0.0621882
GroundWrap_mm	1.524	1.524	1.524	1.524	1.524	1.524
TurnInsulation_mm	0.762	0.762	0.762	0.762	0.762	0.762
PancakeInsulation_mm	0.762	0.762	0.762	0.762	0.762	0.762
ConductorHeight_mm	27	22	**27**	**27**	**27**	**27**
ConductorWidth_mm	22.5	22.5	**22.5**	**22.5**	**22.5**	**22.5**
CornerRadius_mm	2.5	2.5	**2.5**	**2.5**	**2.5**	**2.5**
CornerArea_mm2	5.365045915	5.36504592	5.36504592	5.36504592	5.36504592	5.36504592
CoolingHoleDia_mm	13.5	**13.5**	**13.5**	**13.5**	**13.5**	**13.5**
CoolingArea_mm2	143.1388153	143.138815	143.138815	143.138815	143.138815	143.138815
ConductorArea_mm2	458.9961388	346.496139	458.996139	458.996139	458.996139	458.996139
FillFactor	1	1	1	1	1	1
CopperArea_mm2	458.9961388	346.496139	458.996139	458.996139	458.996139	458.996139
Tstart_K	80	80	80	80	80	80
Resistivity_ohm-m	1.99E-09	1.99E-09	1.99E-09	1.99E-09	1.99E-09	1.99E-09
GeometricResistance_m-1	3.37E+05	5.43E+05	8.28E+05	1.62E+06	1.40E+06	5.91E+05
InitialResistance_ohms	6.70E-04	1.08E-03	1.65E-03	3.21E-03	2.78E-03	1.18E-03
1Vs_OH_MAT	2.286394744	2.77633647	1.04228646	0.85562477	0.0171788	0.0258921
1Vs_OH_A **(Ioh)**	40828	40828	9306	8556	716	3237

PF insulation worksheet	
75	V/mil
6000	V
4000	V
53.3333333	mils
60	mils
1.524	mm
2	coils
1500	V
10	mils
30	mils
0.762	mm

Current waveforms (A)												
	t(s)	M1	M2	M3	PF1	PF2	PF3	PF4	PF5	PF6	TF	Plasma
350kA Ohmic Scenario												
	-0.700	0	0	0	0	0	0	0	0	0	0	0
1.8T low iota	0.000	20068	20763	15815	-18404	-18404	-2797	-2533	-5656	-1986	1869	0
	0.100	20068	20763	15815	-18404	-18404	-2797	-2533	-5656	-1986	1869	0
	0.216	16201	14648	11590	6925	6925	4401	-1865	-2084	7626	16076	-350000
	0.316	16201	14648	11590	11008	11008	5332	-1009	-2013	7950	16076	-350000
350kA	0.516	16201	14648	11590	19174	19174	7193	702	-1870	8597	16076	-350000
Maximum		20068	20763	15815	19174	19174	7193	702	0	8597	16076	0
Minimum		0	0	0	-18404	-18404	-2797	-2533	-5656	-1986	0	-350000
Current direction		1	1	1	0	0	0	0	-1	0	1	
I^2t (A^2-s)		3.98E+08	3.78E+08	2.35E+08	3.20E+08	3.15E+08	2.71E+07	4.38E+06	1.62E+07	2.78E+07	5.50E+08	
t_{ESW}		0.99	0.88	0.94	0.87	0.86	0.52	0.68	0.51	0.38	2.13	
2T High Beta Scenario												
	-0.800	0	0	0	0	0	0	0	0	0	0	0
Low iota vacuum	0.000	22228	22998	17518	16703	16703	5356	4967	-5614	740	2071	0
	0.050	22228	22998	17518	16703	16703	5356	4967	-5614	740	2071	0
2T zero beta	0.118	22697	21265	18432	17652	17652	15890	9241	1662	1691	2420	-205071
	0.213	22685	21392	18008	519	519	16129	13990	4676	-298	2729	-204989
2T high beta	0.218	22685	21392	18008	540	540	16133	13994	4677	-297	2729	-204989
Maximum		22697	22998	18432	17652	17652	16133	13994	4677	1691	2729	0
Minimum		0	0	0	0	0	0	0	-5614	-298	0	-205071
Current direction		1	1	1	1	1	1	1	0	0	1	
I^2t (A^2-s)		4.79E+08	4.75E+08	3.10E+08	2.24E+08	2.18E+08	1.11E+08	1.71E+08	2.14E+07	1.13E+06	2.02E+08	
t_{ESW}		0.93	0.90	0.91	0.72	0.70	0.43	0.87	0.68	0.40	27.16	
1.7T High Beta Scenario												
	-0.700	0	0	0	0	0	0	0	0	0	0	0
High iota vacuum	0.000	22139	20102	17621	3072	3072	13590	15081	-5865	-1678	-4770	0
	0.100	22139	20102	17621	3072	3072	13590	15081	-5865	-1678	-4770	0
	0.158	19292	18075	15668	16053	16053	13746	8074	1431	1521	2057	-174310
	0.258	19283	18184	15307	1569	1569	13966	12128	3995	-164	2320	-174241
	0.458	19283	18184	15307	2386	2386	14152	12299	4009	-99	2320	-174241
Maximum		22139	20102	17621	16053	16053	14152	15081	4009	1521	2320	0
Minimum		0	0	0	0	0	0	0	-5865	-1678	-4770	-174310
Current direction		1	1	1	1	1	1	1	0	0	0	
I^2t (A^2-s)		4.70E+08	3.98E+08	3.07E+08	2.17E+07	2.15E+07	2.04E+08	2.50E+08	2.36E+07	1.38E+06	1.61E+08	
t_{ESW}		0.96	0.99	0.99	0.08	0.08	1.02	1.10	0.69	0.49	7.09	
Initial Ohmic Scenario												
	-1.200	0	0	0	0	0	0	0	0	0	0	0
	0.000	19535	17737	15548	-7496	-7496	9665	11167	-5354	-2290	-4209	0
	0.100	19535	17737	15548	-7496	-7496	9665	11167	-5354	-2290	-4209	0
	0.196	17023	15949	13824	5788	5788	10219	5369	1116	678	1815	-153803
	0.296	17023	15949	13824	9871	9871	11150	6225	1188	1001	1815	-153803
	0.496	17023	15949	13824	18036	18036	13011	7936	1331	1649	1815	-153803
Maximum		19535	17737	15548	18036	18036	13011	11167	1331	1649	1815	0
Minimum		0	0	0	-7496	-7496	0	0	-5354	-2290	-4209	-153803
Current direction		1	1	1	0	0	1	1	0	0	0	
I^2t (A^2-s)		5.23E+08	4.36E+08	3.28E+08	1.52E+08	1.62E+08	1.71E+08	1.53E+08	2.24E+07	5.17E+06	1.47E+08	
t_{ESW}		1.37	1.39	1.36	0.47	0.50	1.01	1.23	0.78	0.99	8.31	
1.7T Ohmic Scenario												
	-0.700	0	0	0	0	0	0	0	0	0	0	0
	0.000	22139	20102	17621	-11218	-11218	10333	12086	-6116	-2811	-4770	0
	0.100	22139	20102	17621	-11218	-11218	10333	12086	-6116	-2811	-4770	0
	0.158	19292	18075	15668	1763	1763	10489	5080	1181	388	2057	-174310
	0.258	19292	18075	15668	5846	5846	11419	5935	1252	712	2057	-174310
	0.458	19292	18075	15668	14012	14012	13281	7647	1395	1359	2057	-174310
Maximum		22139	20102	17621	14012	14012	13281	12086	1395	1359	2057	0
Minimum		0	0	0	-11218	-11218	0	0	-6116	-2811	-4770	-174310
Current direction		1	1	1	0	0	1	1	0	0	0	
I^2t (A^2-s)		4.70E+08	3.97E+08	3.13E+08	1.24E+08	1.25E+08	1.44E+08	1.24E+08	1.69E+07	4.29E+06	1.57E+08	
t_{ESW}		0.96	0.98	1.01	0.63	0.64	0.81	0.85	0.45	0.54	6.90	
Maximum		22697	22998	18432	19174	19174	16133	15081	4677	8597	16076	0
Minimum		0	0	0	-18404	-18404	-2797	-2533	-6116	-2811	-4770	-350000
Maximum I^2t (A^2-s)		5.23E+08	4.75E+08	3.28E+08	3.20E+08	3.15E+08	2.04E+08	2.50E+08	2.36E+07	2.78E+07	5.50E+08	
t_{ESW} (s)		1.02	0.90	0.97	0.87	0.86	0.79	1.10	0.63	0.38	2.13	

Current direction: 1=forward -1=reverse, 0=bidirectional

Temperature (K)											
Scenarios	t(s)	M1	M2	M3	PF1	PF2	PF3	PF4	PF5	PF6	TF
350kA Ohmic											
	-0.700	85	85	85	80	80	80	80	80	80	80
	0.000	94	96	90	81	82	80	80	80	80	80
	0.100	97	99	92	81	82	80	80	80	80	80
	0.216	100	101	93	81	82	80	80	80	80	80
	0.316	102	103	94	81	82	80	80	80	80	80
	0.516	106	106	96	82	83	80	80	80	80	81
	2.697	114	112	101	82	83	80	80	80	80	83
Dissipated Energy (J)		1.58E+07	1.42E+07	7.14E+06	2.19E+05	3.56E+05	4.57E+04	1.38E+04	4.41E+04	3.29E+04	4.72E+06
											4.26E+07
2T High Beta											
	-0.800	85	85	85	80	80	80	80	80	80	80
	0.000	100	102	93	81	82	80	80	80	80	80
	0.050	102	104	94	81	82	80	80	80	80	80
	0.118	104	107	95	81	82	80	80	80	80	80
	0.213	108	110	97	81	82	80	80	80	80	80
	0.218	108	111	97	81	82	80	80	80	80	80
	2.399	121	121	107	81	82	81	81	80	80	81
Dissipated Energy (J)		2.04E+07	1.95E+07	1.02E+07	1.50E+05	2.39E+05	1.91E+05	5.68E+05	5.90E+04	1.32E+03	1.66E+06
											5.30E+07
1.7T High Beta											
	-0.700	85	85	85	80	80	80	80	80	80	80
	0.000	97	94	92	80	80	80	80	80	80	80
	0.100	100	97	94	80	80	80	80	80	80	80
	0.158	102	99	95	80	80	81	81	80	80	80
	0.258	105	101	96	80	80	81	81	80	80	80
	0.458	111	106	100	80	80	81	81	80	80	80
	2.639	120	114	106	80	80	81	81	80	80	81
Dissipated Energy (J)		1.98E+07	1.53E+07	1.00E+07	1.48E+04	2.37E+04	3.43E+05	8.19E+05	6.49E+04	1.58E+03	1.32E+06
											4.78E+07
Initial Ohmic											
	-1.200	85	85	85	80	80	80	80	80	80	80
	0.000	105	101	95	80	80	80	80	80	80	80
	0.100	108	103	97	80	81	80	80	80	80	80
	0.196	111	105	98	80	81	80	80	80	80	80
	0.296	113	107	100	80	81	80	80	80	80	80
	0.496	118	111	103	81	81	81	81	80	80	80
	2.677	125	117	108	81	82	81	81	80	80	81
Dissipated Energy (J)		2.29E+07	1.72E+07	1.08E+07	1.04E+05	1.80E+05	2.86E+05	4.92E+05	6.03E+04	5.91E+03	1.20E+06
											5.32E+07
1.7T Ohmic											
	-0.700	85	85	85	80	80	80	80	80	80	80
	0.000	97	94	92	80	81	80	80	80	80	80
	0.100	100	97	94	80	81	80	80	80	80	80
	0.158	102	99	95	80	81	80	80	80	80	80
	0.258	105	101	97	80	81	80	80	80	80	80
	0.458	111	106	100	81	81	80	80	80	80	80
	2.639	120	114	107	81	81	81	81	80	80	81
Dissipated Energy (J)		1.98E+07	1.53E+07	1.03E+07	8.33E+04	1.37E+05	2.41E+05	3.98E+05	4.56E+04	4.91E+03	1.28E+06
											4.75E+07
Max Final Temperature		125	121	108	82	83	81	81	80	80	83
Max Dissipated Energy (J)		2.29E+07	1.95E+07	1.08E+07	2.19E+05	3.56E+05	3.43E+05	8.19E+05	6.49E+04	3.29E+04	4.72E+06
											5.32E+07

Scenario	Max Active Power (W)	Max Apparent Power (VA)	Stored Energy Required (J)
350kA Ohmic	1.11E+08	3.61E+08	8.48E+07
2T High Beta	1.42E+08	4.00E+08	9.31E+07
1.7T High Beta	1.10E+08	3.83E+08	8.13E+07
Initial Ohmic	6.79E+07	1.97E+08	8.76E+07
1.7T Ohmic	1.09E+08	3.94E+08	8.12E+07
Maximum	1.42E+08	4.00E+08	9.31E+07

Power Supply Requirements										
	M1	M2	M3	PF1	PF2	PF3	PF4	PF5	PF6	TF
Start Phase 1[a]										
Parallel supplies	1	1	1	1	1	1	1	1	1	1
Series supplies	2	2	2	1	1	2	2	2	2	4
Current direction	1	1	1	0	0	1	1	0	0	0
TFTR PSS	2	2	2	2	2	2	2	4	4	8
Total TFTR PSS										30
Start Phase 4[b]										
Parallel supplies	1	1	1	1	1	1	1	1	1	1
Series supplies	4	4	2	2	2	2	6	2	2	6
Current direction	1	1	1	0	0	1	1	0	0	0
TFTR PSS	4	4	2	4	4	2	6	4	4	12
Total TFTR PSS										46
Start Phase 5[c,d,e]										
Parallel supplies	1	1	1	1	1	1	1	1	1	1
Series supplies	4	4	2	2	2	4	6	2	2	6
Current direction	1	1	1	0	0	0	0	0	0	0
TFTR PSS	4	4	2	4	4	8	12	4	4	12
Total TFTR PSS										58
Scenario modeling										
Maximum current (A)	22697	22998	18432	19174	19174	16133	15081	6116	8597	16076
Maximum I^2t (A^2-s)	5.23E+08	4.75E+08	3.28E+08	3.20E+08	3.15E+08	2.04E+08	2.50E+08	2.36E+07	2.78E+07	5.50E+08
t_{ESW} (s)[j]	1.02	0.90	0.97	0.87	0.86	0.79	1.10	0.63	0.38	2.13
Circuit ratings										
Maximum current (A)[g]	24000	24000	24000	24000	24000	21000	19000	8000	11000	18000
Maximum I^2t (A2-s)[h,i]	5.3E+08	5.3E+08	5.3E+08	4.8E+08	4.8E+08	3.1E+08	3.8E+08	4.0E+07	5.0E+07	8.3E+08
t_{ESW} (s)[j]	0.92	0.92	0.92	0.83	0.83	0.70	1.05	0.63	0.41	2.56

[a] Initial ohmic scenario only

[b] Provides for the initial ohmic, the 1.7T ohmic, and the 1.7T high beta scenarios

[c] Provides for the initial ohmic, the 1.7T ohmic, the 1.7T high beta, the 2T high beta, and the 350kA ohmic scenarios

[d] The TF circuit should be broken into 3 circuits (6 coils in each) with a 24kA, 2kV bi-directional supply in each circuit for Phase 5

[e] The capability to provide differential currents of TBD amps in a PF pair should be provided

[f] Current direction: 1=forward -1=reverse, 0=bidirectional

[g] Maximum rated current is the minimum of 24kA and approximately 1.25 times the maximum current in the scenario modeling except for TF. TF is rated for 0.5T (16204 A) at 1.4m during normal operation plus a 10% overshoot during rampdown.

[h] Maximum I^2t in the modular coil circuits is equal to the largest I^2t in any of the modular coil circuits in the scenario modeling

[i] Maximum I^2t in the TF and PF circuits is approximately equal to 1.5 times the maximum I^2t in the scenario modeling

[j] Calculated from the maximum current and the maximum I^2t

	M1	M2	M3	PF1	PF2	PF3	PF4	PF5	PF6	TF
Coil Inductance (mH)	38.28	28.48	31.38	1.92	2.43	8.10	25.85	11.99	2.16	48.19
Line inductance (mH)	0.13									
Initial coil resistance (mW)	27.58	26.75	24.52	0.67	1.08	1.65	3.21	2.78	1.18	8.10
Line resistance (mW)	17.20									

Notes: The line inductance and resistance are assumed to be the same for each circuit
Coil inductance and resistances are calculated for all coils in series

Cryogenic Cooling Requirements

Pulsed Heat Loads	M1	M2	M3	PF1	PF2	PF3	PF4	PF5	PF6	TF
Maxima From Scenario Modeling										
Initial Temperature (K)	85.00	85.00	85.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Max Temperature (K)	125.13	120.62	108.06	81.74	83.05	81.36	81.36	80.13	80.15	83.03
Energy Deposited (J)	2.29E+07	1.95E+07	1.08E+07	2.19E+05	3.56E+05	3.43E+05	8.19E+05	6.49E+04	3.29E+04	4.72E+06
										5.32E+07
Design Values for Analysis of Coil Cooldown and Cryogenic System Requirements										
Initial Temperature (K)	85	85	85	80	80	80	80	80	80	80
Max Temperature (K) [a]	125	125	125	82.61	84.58	82.03	82.03	80.19	80.22	84.54
Energy Deposited (J) [b]	2.28E+07	2.19E+07	1.87E+07	3.28E+05	5.34E+05	5.15E+05	1.23E+06	9.73E+04	4.93E+04	7.08E+06
										7.33E+07

LN2 Consumption		Tsat (K)	Psat (MPa)	hfg (kJ/kg)	Mass per pulse (kg)	Density (kg/m3)	(m3/kg)	Volume (m3)	(liters)	(gallons)	
Per shot		78.0	0.1077	199	369	806	0.00124	0.46	457	121	per shot
Time between shots (minutes)	15										
Hours per day	8										
Full pwr shots per day	32									3867	per day
Operating days per week	5									19337	per week

Parasitic Heat Loads

Normal (20C VV temperature)	Heat Load (kW)	Flow rate (kg/s)	Vol flow rate (m3/s)	s/week	Volume (m3)	(liters)	(gallons)	
Cryostat gaseous nitrogen circulation	7.1							
Through cryostat	3.4							
Through ports	2.4							
From VV to modular coil shell	1.3							
Modular coil liquid nitrogen cooling (from VV)	3.4							
Combined	10.5	0.053	0.000066	604800	40	39658	10477	per week
VV heating required	*7.1*							

Bakeout (150C VV temperature)	Heat Load (kW)	Flow rate (kg/s)	Vol flow rate (m3/s)	s/week	Volume (m3)	(liters)	(gallons)	
Cryostat gaseous nitrogen circulation	9.6							
Through cryostat	3.4							
Through ports	4.0							
From VV to modular coil shell	2.2							
Modular coil liquid nitrogen cooling (from VV)	5.7							
Combined	15.3	0.077	0.000096	604800	58	57788	15266	per week
VV heating required	*11.9*							

Cooldown

Cold mass	92273	kg
Cryogen requirements	0.43	kg of LN2 per kg of SS assuming evaporation enthalpy only per http://gperinic.home.cern.ch/gperinic/cooldown.htm
	0.27	kg of LN2 per kg of SS assuming evaporation plus vapor enthalpy (not used in this calculation)
	39677	kg based on evaporation enthalpy only
	13009	gallons

LN2 delivery requirements

	gallons/truck	trucks	
Pulsed heat loads only	6500	3.0	per week
Parasitic loads only			
Normal		1.6	per week
Bakeout		2.3	per week
Cooldown only		2.0	

[a] Modular coil temperatures limited to 125K, which corresponds to a temperature rise of 40K

[b] The maximum energy deposited in the PF and TF coils was increased by 50% over the maximum for each coil in the scenario modeling