APPENDIX 2

DATA FOR IEEE 118 BUS SYSTEM

This IEEE 118 bus system data are taken from http://www.ee.washington.edu/research /pstca. The bus data, line data are given in Table A2.1 and A2.2. The generator real power and reactive power limits are shown separately in Table A2.3.

Table A2.1 Bus Data for IEEE 118 -bus system

Bus Number	Type of Bus	V (p.u.)	P_d (MW)	Q_d (MVAr)	P_g (MW)	Q_g (MVAr)
1	PQ	1.0	51	27	0	0
2	PQ	1.1	20	9	0	0
3	PQ	1.0	39	10	0	0
4	PQ	1.0	39	12	0	0
5	PQ	1.0	0	0	0	0
6	PQ	1.0	52	22	0	0
7	PQ	1.0	19	2	0	0
8	PQ	1.0	28	0	0	0
9	PQ	1.0	0	0	0	0
10	PV	1.050	0	0	450	-
11	PQ	1.0	70	23	0	0
12	PV	0.990	47	10	85	-
13	PQ	1.0	34	16	0	0
14	PQ	1.0	14	1	0	0
15	PQ	1.0	90	30	0	0
16	PQ	1.0	25	10	0	0
17	PQ	1.0	11	3	0	0
18	PQ	1.0	60	34	0	0

Table A2.1 (Continued)

Bus Number	Type of Bus	V (p.u.)	P_d (MW)	Q_d (MVAr)	P_g (MW)	Q_g (MVAr)
19	PQ	1.0	45	25	0	0
20	PQ	1.0	18	3	0	0
21	PQ	1.0	14	8	0	0
22	PQ	1.0	10	5	0	0
23	PQ	1.0	7	3	0	0
24	PQ	1.0	13	0	0	0
25	PV	1.050	0	0	220	-
26	PV	1.015	0	0	314	-
27	PQ	1.0	71	13	0	0
28	PQ	1.0	17	7	0	0
29	PQ	1.0	24	4	0	0
30	PQ	1.0	0	0	0	0
31	PV	0.967	43	27	7	-
32	PQ	1.0	59	23	0	0
33	PQ	1.0	23	9	0	0
34	PQ	1.0	59	26	0	0
35	PQ	1.0	33	9	0	0
36	PQ	1.0	31	17	0	0
37	PQ	1.0	0	0	0	0
38	PQ	1.0	0	0	0	0
39	PQ	1.0	27	11	0	0
40	PQ	1.0	66	23	0	0
41	PQ	1.0	37	10	0	0
42	PQ	1.0	96	23	0	0
43	PQ	1.0	18	7	0	0
44	PQ	1.0	16	8	0	0
45	PQ	1.0	53	22	0	0
46	PV	1.005	28	10	19	-
47	PQ	1.0	34	0	0	0
48	PQ	1.0	20	11	0	0
49	PV	1.025	87	30	204	-
50	PQ	1.0	17	4	0	0

Table A2.1 (Continued)

Bus Number	Type of Bus	V (p.u.)	P_d (MW)	Q_d (MVAr)	P_g (MW)	Q_g (MVAr)
51	PQ	1.0	17	8	0	0
52	PQ	1.0	18	5	0	0
53	PQ	1.0	23	11	0	0
54	PV	0.955	113	32	48	-
55	PQ	1.0	63	22	0	0
56	PQ	1.0	84	18	0	0
57	PQ	1.0	12	3	0	0
58	PQ	1.0	12	3	0	0
59	PV	0.985	277	113	155	-
60	PQ	1.0	78	3	0	0
61	PV	0.995	0	0	160	-
62	PQ	1.0	77	14	0	0
63	PQ	1.0	0	0	0	0
64	PQ	1.0	0	0	0	0
65	PV	1.005	0	0	391	-
66	PV	1.050	39	18	392	-
67	PQ	1.0	28	7	0	0
68	PQ	1.0	0	0	0	0
69	SLACK	1.035	0	0	-	-
70	PQ	1.0	66	20	0	0
71	PQ	1.0	0	0	0	0
72	PQ	1.0	12	0	0	0
73	PQ	1.0	6	0	0	0
74	PQ	1.0	68	27	0	0
75	PQ	1.0	47	11	0	0
76	PQ	1.0	68	36	0	0
77	PQ	1.0	61	28	0	0
78	PQ	1.0	71	26	0	0
79	PQ	1.0	39	32	0	0
80	PV	1.040	130	26	477	-
81	PQ	1.0	0	0	0	0
82	PQ	1.0	54	27	0	0
83	PQ	1.0	20	10	0	0
84	PQ	1.0	11	7	0	0

Table A2.1 (Continued)

Bus Number	Type of Bus	V (p.u.)	P_d (MW)	Q_d (MVAr)	P_g (MW)	Q_g (MVAr)
85	PQ	1.0	24	15	0	0
86	PQ	1.0	21	10	0	0
87	PV	1.015	0	0	4	-
88	PQ	1.0	48	10	0	0
89	PV	1.005	0	0	607	-
90	PQ	1.0	163	48	0	0
91	PQ	1.0	10	0	0	0
92	PQ	1.0	65	10	0	0
93	PQ	1.0	12	7	0	0
94	PQ	1.0	30	16	0	0
95	PQ	1.0	42	31	0	0
96	PQ	1.0	38	15	0	0
97	PQ	1.0	15	9	0	0
98	PQ	1.0	34	8	0	0
99	PQ	1.0	42	0	0	0
100	PV	1.017	37	18	252	-
101	PQ	1.0	22	15	0	0
102	PQ	1.0	5	3	0	0
103	PV	1.010	23	16	40	-
104	PQ	1.0	38	25	0	0
105	PQ	1.0	31	26	0	0
106	PQ	1.0	43	16	0	0
107	PQ	1.0	50	12	0	0
108	PQ	1.0	2	1	0	0
109	PQ	1.0	8	3	0	0
110	PQ	1.0	39	30	0	0
111	PV	0.98	0	0	36	-
112	PQ	1.0	68	13	0	0
113	PQ	1.0	6	0	0	0
114	PQ	1.0	8	3	0	0
115	PQ	1.0	22	7	0	0
116	PQ	1.0	184	0	0	0
117	PQ	1.0	20	8	0	0
118	PQ	1.0	33	15	0	0

Table A2.2 Line Data for IEEE 118 - bus system

Line Number	From Bus	To Bus	R (p.u.)	X (p.u)	Half line Charging Suceptance (p.u)	Tap setting	Thermal Limit (MVA)
1	1	2	0.0303	0.0999	0.0254	1	200
2	1	3	0.0129	0.0424	0.0108	1	200
3	2	12	0.0187	0.0616	0.0157	1	200
4	3	5	0.0241	0.108	0.0284	1	200
5	3	12	0.0484	0.16	0.0406	1	200
6	4	5	0.00176	0.00798	0.0021	1	800
7	4	11	0.0209	0.0688	0.0175	1	200
8	5	6	0.0119	0.054	0.0143	0.985	200
9	5	11	0.0203	0.0682	0.0174	1	200
10	6	7	0.00459	0.0208	0.0055	1	800
11	7	12	0.00862	0.034	0.0087	1	800
12	8	5	0	0.0267	0	1	1000
13	8	9	0.00244	0.0305	1.162	1	800
14	8	30	0.00431	0.0504	0.514	1	800
15	9	10	0.00258	0.0322	1.23	1	800
16	11	12	0.00595	0.0196	0.005	1	800
17	11	13	0.02225	0.0731	0.0188	1	200
18	12	14	0.0215	0.0707	0.0182	1	200
19	12	16	0.0212	0.0834	0.0214	1	200
20	12	117	0.0329	0.14	0.0358	1	200
21	13	15	0.0744	0.2444	0.0627	1	200
22	14	15	0.0595	0.195	0.0502	1	200
23	15	17	0.0132	0.0437	0.0444	1	200
24	15	19	0.012	0.0394	0.0101	1	200
25	15	33	0.038	0.1244	0.0319	1	200
26	16	17	0.0454	0.1801	0.0466	1	200
27	17	18	0.0123	0.0505	0.0129	1	200
28	17	31	0.0474	0.1563	0.0399	1	200
29	17	113	0.00913	0.0301	0.0077	1	800
30	18	19	0.01119	0.0493	0.0114	1	200

Table A2.2 (Continued)

Line Number	From Bus	To Bus	R (p.u.)	X (p.u)	Half line Charging Suceptance (p.u)	Tap setting	Thermal Limit (MVA)
31	19	20	0.0252	0.117	0.0298	1	200
32	19	34	0.0752	0.247	0.0632	0.96	200
33	20	21	0.0183	0.0849	0.0216	1	200
34	21	22	0.0209	0.097	0.0246	1	200
35	22	23	0.0342	0.159	0.0404	1	200
36	23	24	0.0135	0.0492	0.0498	0.96	200
37	23	25	0.0156	0.08	0.0864	1	800
38	23	32	0.0317	0.1153	0.1173	1	200
39	24	70	0.00221	0.4115	0.1019	1	200
40	24	72	0.0488	0.196	0.0488	1	200
41	25	27	0.0318	0.163	0.1764	1	200
42	26	25	0	0.0382	0	1	1000
43	26	30	0.00799	0.086	0.908	1	800
44	27	28	0.01913	0.0855	0.0216	1	200
45	27	32	0.0229	0.0755	0.0193	1	200
46	27	115	0.0164	0.0741	0.0197	1	200
47	28	29	0.0237	0.0943	0.0238	1	200
48	29	31	0.0108	0.0331	0.0083	1	200
49	30	17	0	0.0388	0	1	1000
50	30	38	0.00464	0.054	0.422	1	800
51	31	32	0.0298	0.0985	0.0251	0.935	200
52	32	113	0.0615	0.203	0.0518	1	200
53	32	114	0.0135	0.0612	0.0163	1	200
54	33	37	0.0415	0.142	0.0366	1	200
55	34	36	0.00871	0.0268	0.0057	1	800
56	34	37	0.00256	0.0094	0.0098	1	800
57	34	43	0.0413	0.1681	0.0423	1	200
58	35	36	0.00224	0.0102	0.0027	1	800
59	35	37	0.011	0.0497	0.0132	1	200
60	37	39	0.0321	0.106	0.027	1	200

Table A2.2 (Continued)

Line Number	From Bus	To Bus	R (p.u.)	X (p.u)	Half line Charging Suceptance (p.u)	Tap setting	Thermal Limit (MVA)
61	37	40	0.0593	0.168	0.042	1	200
62	38	37	0	0.0375	0	1	1000
63	38	65	0.00901	0.0986	1.046	1	800
64	39	40	0.0184	0.0605	0.0155	1	200
65	40	41	0.0145	0.0487	0.0122	1	200
66	40	42	0.0555	0.183	0.0466	1	200
67	41	42	0.041	0.135	0.0344	1	200
68	42	49	0.0357	0.1615	0.0215	1	200
69	43	44	0.0608	0.2454	0.0607	1	200
70	44	45	0.0224	0.0901	0.0224	1	200
71	45	46	0.04	0.1356	0.0332	1	200
72	45	49	0.0684	0.186	0.0444	1	200
73	46	47	0.038	0.127	0.0316	1	200
74	46	48	0.0601	0.189	0.0472	1	200
75	47	49	0.0191	0.0625	0.016	1	200
76	47	69	0.0844	0.2778	0.0709	1	200
77	48	49	0.0179	0.0505	0.0126	1	200
78	49	50	0.0267	0.0752	0.0187	1	200
79	49	51	0.0486	0.137	0.0342	1	200
80	49	54	0.0397	0.145	0.0183	1	200
81	49	66	0.009	0.0459	0.0062	1	800
82	49	69	0.0985	0.324	0.0828	1	200
83	50	57	0.0474	0.134	0.0332	1	200
84	51	52	0.0203	0.0588	0.0139	1	200
85	51	58	0.0255	0.0719	0.0179	1	200
86	52	53	0.0405	0.1635	0.0406	1	200
87	53	54	0.0263	0.122	0.031	1	200
88	54	55	0.0169	0.0707	0.0202	1	200
89	54	56	0.00275	0.00955	0.0073	1	800
90	54	59	0.0503	0.2293	0.0598	0.96	200

Table A2.2 (Continued)

Line Number	From Bus	To Bus	R (p.u.)	X (p.u)	Half line Charging Suceptance (p.u)	Tap setting	Thermal Limit (MVA)
91	55	56	0.00488	0.0151	0.0037	1	800
92	55	59	0.04739	0.2158	0.0565	0.985	200
93	56	57	0.0343	0.0966	0.0242	1	200
94	56	58	0.0343	0.0966	0.0242	1	200
95	56	59	0.0407	0.1224	0.0138	1	200
96	59	60	0.0317	0.145	0.0376	1	200
97	59	61	0.0328	0.15	0.0388	1	200
98	60	61	0.00264	0.0135	0.0146	0.935	800
99	60	62	0.0123	0.0561	0.0147	1	200
100	61	62	0.00824	0.0376	0.0098	1	800
101	62	66	0.0482	0.218	0.0578	1	200
102	62	67	0.0258	0.117	0.031	1	200
103	63	59	0	0.0386	0	0.935	800
104	63	64	0.00172	0.02	0.216	1	800
105	64	61	0	0.0268	0	1	800
106	65	68	0.00138	0.016	0.638	1	800
107	66	67	0.0224	0.1015	0.0268	1	200
108	68	69	0	0.037	0	1	800
109	68	81	0.00175	0.0202	0.808	1	800
110	68	116	0.00034	0.00405	0.164	1	1000
111	69	70	0.03	0.127	0.122	1	200
112	69	75	0.0405	0.122	0.124	1	200
113	69	77	0.0309	0.101	0.1038	1	200
114	70	71	0.00882	0.0355	0.0088	1	800
115	70	74	0.0401	0.1323	0.0337	1	200
116	70	75	0.0428	0.141	0.036	1	200
117	71	72	0.0446	0.18	0.0444	1	200
118	71	73	0.00866	0.0454	0.0118	1	800
119	74	75	0.0123	0.0406	0.0103	1	200
120	75	77	0.0601	0.1999	0.0498	0.935	200

Table A2.2 (Continued)

Line Number	From Bus	To Bus	R (p.u.)	X (p.u)	Half line Charging Suceptance (p.u)	Tap setting	Thermal Limit (MVA)
121	75	118	0.0145	0.0481	0.0119	1	200
122	76	77	0.0444	0.148	0.0368	1	200
123	76	118	0.0164	0.0544	0.0136	1	200
124	77	78	0.00376	0.0124	0.0126	1	800
125	77	80	0.0108	0.0332	0.0028	1	200
126	77	82	0.0298	0.0853	0.0817	1	200
127	78	79	0.00546	0.0244	0.0065	1	800
128	79	80	0.0156	0.0704	0.0187	1	200
129	80	96	0.0356	0.182	0.0494	1	200
130	80	97	0.0183	0.0934	0.0254	1	200
131	80	98	0.0238	0.108	0.0286	1	200
132	80	99	0.0454	0.206	0.0546	1	200
133	81	80	0	0.037	0	1	800
134	82	83	0.0112	0.03665	0.0379	1	200
135	82	96	0.0162	0.053	0.0544	1	200
136	83	84	0.0625	0.132	0.0258	1	200
137	83	85	0.043	0.148	0.0348	1	200
138	84	85	0.0302	0.0641	0.0123	1	200
139	85	86	0.035	0.123	0.0276	1	200
140	85	88	0.02	0.102	0.0276	1	200
141	85	89	0.0239	0.173	0.047	1	200
142	86	87	0.02828	0.2074	0.0445	1	200
143	88	89	0.0139	0.0712	0.0193	1	200
144	89	90	0.0163	0.0651	0.0176	1	200
145	89	92	0.0079	0.0383	0.0118	1	800
146	90	91	0.0254	0.0836	0.0214	1	200
147	91	92	0.0387	0.1272	0.0327	1	200
148	92	93	0.0258	0.0848	0.0218	1	200
149	92	94	0.0481	0.158	0.0406	1	200
150	92	100	0.0648	0.295	0.0472	1	200

Table A2.2 (Continued)

Line Number	From Bus	To Bus	R (p.u.)	X (p.u)	Half line Charging Suceptance (p.u)	Tap setting	Thermal Limit (MVA)
151	92	102	0.0123	0.0559	0.01464	1	200
152	93	94	0.0223	0.0732	0.0188	1	200
153	94	95	0.0132	0.0434	0.0111	1	200
154	94	96	0.0269	0.0869	0.023	1	200
155	94	100	0.0178	0.058	0.0604	1	200
156	95	96	0.0171	0.0547	0.01474	1	200
157	96	97	0.0173	0.0885	0.024	1	200
158	98	100	0.0397	0.179	0.0476	1	200
159	99	100	0.018	0.0813	0.0216	1	200
160	100	101	0.0277	0.1262	0.0328	1	200
161	100	103	0.016	0.0525	0.0536	1	200
162	100	104	0.0451	0.204	0.0541	1	200
163	100	106	0.0605	0.229	0.062	1	200
164	101	102	0.0246	0.112	0.0294	1	200
165	103	104	0.0466	0.1584	0.0407	1	200
166	103	105	0.0535	0.1625	0.0408	1	200
167	103	110	0.03906	0.1813	0.0461	1	200
168	104	105	0.00994	0.0378	0.0099	1	800
169	105	106	0.014	0.0547	0.0143	1	200
170	105	107	0.053	0.183	0.0472	1	800
171	105	108	0.0261	0.0703	0.0184	1	200
172	106	107	0.053	0.183	0.0472	1	200
173	108	109	0.0105	0.0288	0.0076	1	200
174	109	110	0.0278	0.0762	0.0202	1	200
175	110	111	0.022	0.0755	0.02	1	200
176	110	112	0.0247	0.064	0.062	1	200
177	114	115	0.0023	0.0104	0.0028	1	800

Table A2.3 Real and Reactive Power Limits of Generators – IEEE 118 bus system

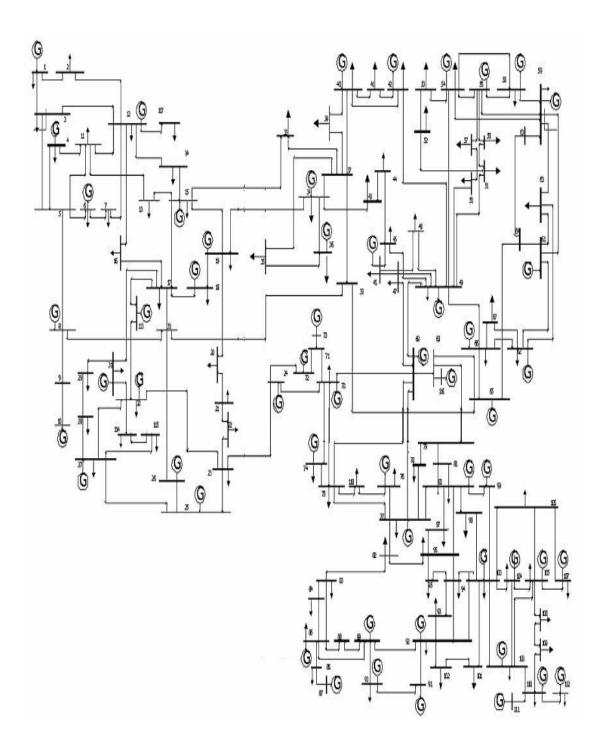| Bus No.	P_{min} (MW)	P_{max} (MW)	Q_{min} (MVAr)	Q_{max} (MVAr)
10	0	550	-14	200
12	0	185	-35	120
25	0	320	-47	140
26	0	414	-10	150
31	0	107	-30	90
46	0	119	-100	100
49	0	304	-25	90
54	0	148	-30	80
59	0	255	-60	180
61	0	260	-50	160
65	0	491	-67	200
66	0	492	-67	200
69	0	805.2	-300	300
80	0	577	-165	280
87	0	104	-20	60
89	0	707	-210	300
100	0	352	-50	155
103	0	140	-15	40
111	0	136	-30	45

Figure A2.1 Single line diagram IEEE-118 bus systems