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# Appendix-A

## IEEE 9-bus System Data

The details of the IEEE 9-bus system are taken from [64, 74]. The single-line diagram of the system is shown in Fig. A.1. Generator data, exciter data, transformer data and transmission line data are shown in Table A.1, Table A.2, Table A.3 and Table A.4, respectively.

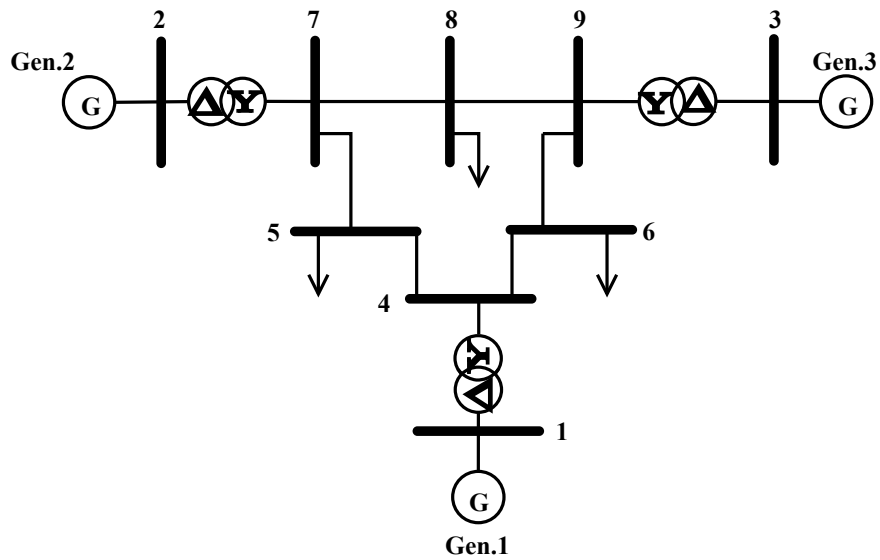


Figure A.1: Single line diagram of IEEE 9-bus power system.

Table A.1: Generator data (100 MVA Base)

Parameters	SG-1	SG-2	SG-3
$H(\text{sec})$	23.64	6.4	3.01
$X_d$ (p.u.)	0.146	0.895	1.312
$X'_d$ (p.u.)	0.060	0.119	0.181
$X_q$ (p.u.)	0.096	0.864	1.257
$X'_q$ (p.u.)	0.096	0.196	0.25
$T'_{do}$ (p.u.)	8.96	6.0	5.89
$T'_{qo}$ (p.u.)	0.31	0.535	0.6

Table A.2: Generator exciter data

Parameters	SG-1	SG-2	SG-3
$K_A$	20	20	20
$T_A$ (sec)	0.2	0.2	0.2
$K_E$	1.0	1.0	1.0
$T_E$ (sec)	0.314	0.314	0.314
$K_F$	0.063	0.063	0.063
$T_F$ (sec)	0.35	0.35	0.35

Table A.3: Transformer data

From Bus	To bus	Resistance, R (p.u.)	Reactance, X (p.u.)	Susceptance, B (p.u.)	Tape Ratio
1	4	0.0	0.0576	0.0	1.0
2	7	0.0	0.0625	0.0	1.0
3	9	0.0	0.0586	0.0	1.0

Table A.4: Transmission line data

From Bus	To bus	Resistance, R (p.u.)	Reactance, X (p.u.)	Susceptance, B (p.u.)
4	5	0.010	0.085	0.176
4	6	0.017	0.092	0.158
5	7	0.032	0.161	0.306
6	9	0.039	0.170	0.358
7	8	0.0085	0.072	0.149
8	9	0.011	0.1008	0.209



Table B.2: Generator exciter data

Parameters	SG-1	SG-2	SG-3	SG-4	SG-5
$K_A$	6.2	6.2	6.2	6.2	6.2
$T_A$ (sec)	0.05	0.05	0.05	0.05	0.05
$K_E$	1.0	1.0	1.0	1.0	1.0
$T_E$ (sec)	0.83	0.83	0.83	0.83	0.83
$K_F$	0.057	0.057	0.057	0.057	0.057
$T_F$ (sec)	0.5	0.5	0.5	0.5	0.5

Table B.3: Transformer data

From Bus	To Bus	Resistance, R (p.u.)	Reactance, X (p.u.)	Tap ratio
4	7	0.0	0.209	0.978
4	9	0.0	0.556	0.969
5	6	0.0	0.252	0.932
7	8	0.0	0.176	1.000
7	9	0.0	0.110	1.000

Table B.4: Transmission line data

From Bus	To Bus	Resistance, R (p.u.)	Reactance, X (p.u.)	Susceptance, B (p.u.)
1	2	0.0193	0.0591	0.0264
1	5	0.0540	0.2230	0.0246
2	3	0.0469	0.1979	0.0219
2	4	0.0581	0.1763	0.0187
3	4	0.0670	0.1710	0.0173
4	5	0.0133	0.0421	0.0064
6	11	0.0949	0.1989	—
6	12	0.1229	0.2558	—
6	13	0.0661	0.1302	—
9	10	0.0318	0.0845	—
9	14	0.1271	0.2703	—
10	11	0.0820	0.1920	—
12	13	0.2209	0.1998	—
13	14	0.1709	0.3480	—

# Appendix-C

## New England Ten Machine System Data

The details of the New England 39 bus system are taken from [92]. The single-line diagram of the system is shown in Fig. C.1. Generator data, exciter data, transformer data and transmission line data are shown in Table C.1, Table C.2, Table C.3 and Table C.4, respectively.

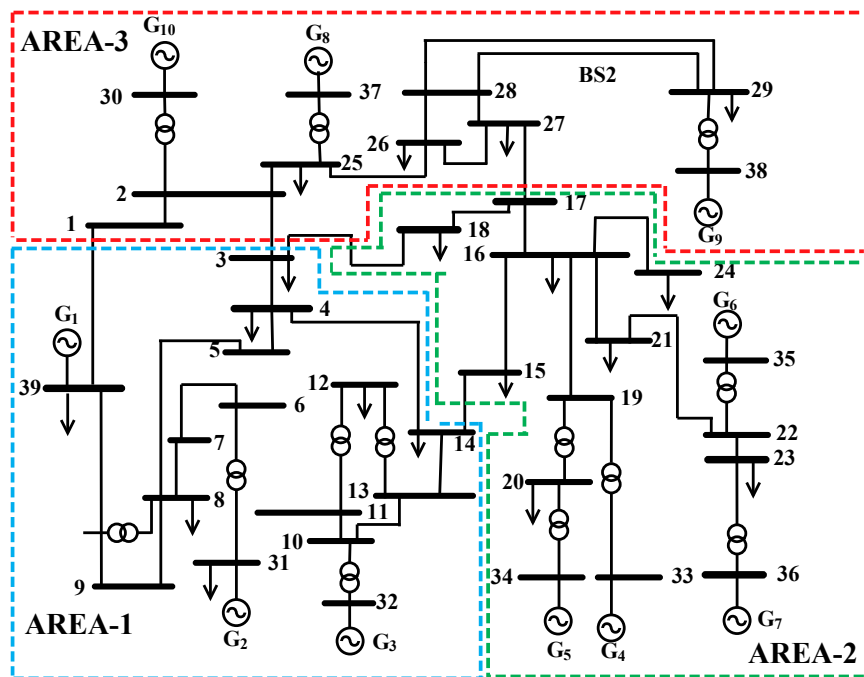


Figure C.1: Single line diagram of New England 39-bus system.

Table C.1: Generator data (1000 MVA Base)

Parameters	SG-1	SG-2	SG-3	SG-4	SG-5	SG-6	SG-7	SG-8	SG-9	SG-10
H(sec)	50	3.03	3.58	2.86	2.6	3.48	2.64	2.43	3.45	4.2
$X_d$ (p.u.)	0.2	2.95	2.495	2.62	6.7	2.54	2.95	2.9	2.106	1
$X'_d$ (p.u.)	0.06	0.697	0.531	0.436	1.32	0.5	0.49	0.57	0.57	0.31
$X_q$ (p.u.)	0.19	2.82	2.37	2.58	6.2	2.41	2.92	2.8	2.05	0.69
$X'_q$ (p.u.)	0.08	1.7	0.876	1.66	1.66	0.814	1.86	0.911	0.587	0.3
$T'_{do}$ (p.u.)	7.0	6.56	5.7	5.69	5.4	7.3	5.66	6.7	4.79	10.2
$T'_{qo}$ (p.u.)	0.7	1.5	1.5	1.5	0.44	0.4	1.5	0.41	1.96	1.5

Table C.2: Generator exciter data

Parameters	SG-2	SG-3	SG-4	SG-5	SG-6	SG-7	SG-8	SG-9	SG-10
$K_A$	6.2	5.0	5.0	40.0	5.0	40.0	5.0	40.0	5.0
$T_A$ (sec)	0.05	0.06	0.06	0.02	0.02	0.02	0.02	0.02	0.06
$K_E$	-0.633	-0.019	-0.052	1.0	-0.041	1.0	-0.047	1.0	-0.048
$T_E$ (sec)	0.405	0.500	0.500	0.785	0.471	0.730	0.528	1.400	0.250
$K_F$	0.057	0.080	0.080	0.030	0.754	0.030	0.085	0.030	0.040
$T_F$ (sec)	0.5	1.0	1.0	1.0	1.246	1.0	1.260	1.0	1.0

Table C.3: Transformer data

From Bus	To bus	Resistance, R (p.u.)	Reactance, X (p.u.)	Susceptance, B (p.u.)	Tape Ratio
12	11	0.0016	0.0435	0.0	1.006
12	13	0.0016	0.0435	0.0	1.006
6	31	0.0	0.0250	0.0	1.070
10	32	0.0	0.0200	0.0	1.070
19	33	0.0007	0.0142	0.0	1.009
20	34	0.0009	0.0180	0.0	1.009
22	35	0.0	0.0143	0.0	1.025
23	36	0.0005	0.0272	0.0	1.0
25	37	0.0006	0.0232	0.0	1.025
2	30	0.0	0.0181	0.0	1.025
29	38	0.0008	0.0156	0.0	1.025
19	20	0.0007	0.0138	0.0	1.060

Table C.4: Transmission line data

From Bus	To Bus	Resistance, R (p.u.)	Reactance, X (p.u.)	Susceptance, B (p.u.)
1	2	0.0035	0.0411	0.698
1	39	0.0010	0.0250	0.750
2	3	0.0013	0.0151	0.257
2	25	0.0070	0.0086	0.1460
3	4	0.0013	0.0213	0.2214
3	18	0.0011	0.0133	0.2138
4	5	0.0008	0.0128	0.1342
4	14	0.0008	0.0129	0.1382
5	6	0.0002	0.00026	0.0434
5	8	0.0008	0.0112	0.1476
6	7	0.0006	0.0092	0.1130
6	11	0.0007	0.0082	0.1389
7	8	0.0004	0.0046	0.0780
8	9	0.0023	0.0363	0.3804
9	39	0.0010	0.0250	1.2000
10	11	0.0004	0.0043	0.0729
10	13	0.0004	0.0043	0.0729
13	14	0.0009	0.0101	0.1723
14	15	0.0018	0.0217	0.3660
15	16	0.0009	0.0094	0.1710
16	17	0.0007	0.0089	0.1342
16	19	0.0016	0.0195	0.3040
16	21	0.0008	0.0135	0.2548
16	24	0.0003	0.0059	0.0680
17	18	0.0007	0.0082	0.1319
17	27	0.0013	0.0173	0.3216
21	22	0.0008	0.0140	0.2565
22	23	0.0006	0.0096	0.1846
23	24	0.0022	0.0350	0.3610
25	26	0.0032	0.0323	0.5130
26	27	0.0014	0.0147	0.2396
26	28	0.0043	0.0474	0.7802
26	29	0.0057	0.0625	1.0290
28	29	0.0014	0.0151	0.2490



# List of Publications

1. **Rohit Kumar**, Soumya. R. Mohanty, and M. K. Verma, “A robust damping control for battery energy storage integrated power systems to mitigate inter- area oscillations,” International Journal of Electrical Power & Energy Systems, vol. 157, paper no. 109885, 2024.
2. **Rohit Kumar**, Soumya. R. Mohanty, and Mitresh Kumar Verma, “Robust damping control for integrated wind turbine power networks during low inertia condition,” International Journal of Circuit Theory and Applications, 2024, Doi:10.1002/cta.3991.
3. **Rohit Kumar**, Soumya. Mohanty, and M. K. Verma, “Design and optimal location of power system stabilizer in the multi-machine power network,” IETE Journal of Research, vol. 70, no. 3, pp. 2782-2801, 2024.
4. **Rohit Kumar**, Soumya. R. Mohanty, and Mitresh Kumar Verma, “Enhancing Damping of Low-Frequency Oscillations in Power Networks through Energy Storage System-Based Controller,” International Journal of Circuit Theory and Applications, (Accepted).
5. **Rohit Kumar**, Soumya. R. Mohanty, and M. K. Verma, “ Robust Damping Control Scheme for VSG-Enabled Inverter-Based Resources in Low Inertia Bus Power Networks to Mitigate Low-Frequency Oscillations,”( Work under progress).