

IEEE 118-BUS MODIFIED TEST SYSTEM DATA

Nomenclature

Rated MVA	Machine-rated MVA; base MVA for impedances
Rated kV	Machine-rated terminal voltage in kV; base kV for impedances
H	Inertia constant in s
D	Machine load damping coefficient
r_a	Armature resistance in p.u.
x_d	Unsaturated d axis synchronous reactance in p.u.
x_q	Unsaturated q axis synchronous reactance in p.u.
x'_d	Unsaturated d axis transient reactance in p.u.
x'_q	Unsaturated q axis transient reactance in p.u.
x''_d	Unsaturated d axis subtransient reactance in p.u.
x''_q	Unsaturated q axis subtransient reactance in p.u.
x_l or x_p	Leakage or Potier reactance in p.u.
T'_{d0}	d axis transient open circuit time constant in s
T'_{q0}	q axis transient open circuit time constant in s
T''_{d0}	d axis subtransient open circuit time constant in s
T''_{q0}	q axis subtransient open circuit time constant in s
$S(1.0)$	Machine saturation at 1.0 p.u. voltage in p.u.
$S(1.2)$	Machine saturation at 1.2 p.u. voltage in p.u.
T_r	Regulator input filter time constant in s
K_a	Regulator gain (continuous acting regulator) in p.u.
T_a	Regulator time constant in s
V_{Rmax}	Maximum regulator output, starting at full load field voltage in p.u.
V_{Rmin}	Minimum regulator output, starting at full load field voltage in p.u.
K_e	Exciter self-excitation at full load field voltage in p.u.
T_e	Exciter time constant in s
K_f	Regulator stabilizing circuit gain in p.u.
T_f	Regulator stabilizing circuit time constant in s
E_1	Field voltage value,1 in p.u.
$SE(E_1)$	Saturation factor at E_1
E_2	Field voltage value,2 in p.u.
$SE(E_2)$	Saturation factor at E_2
P_{max}	Maximum turbine output in p.u.
R	Turbine steady-state regulation setting or droop in p.u.
T_1	Control time constant (governor delay) in s
T_2	Hydro reset time constant in s
T_3	Servo time constant in s
T_4	Steam valve bowl time constant in s
T_5	Steam reheat time constant in s
F	Shaft output ahead of reheater in p.u.

TABLE I(1)
IEEE 118-BUS MODIFIED TEST SYSTEM GENERATOR DATA

Type	GENROU	GENROU	GENROU	GENROU	GENROU
Operation	Sync. Gen.	Sync. Gen.	Sync. Gen.	Sync. Gen.	Sync. Gen.
Default Unit no.	10(119)		25(121)		31(123)
(New Unit no.)	69(131)	12(120)	49(125)	26(122)	46(124)
	80(132)		100(135)		87(133)
Rated power (MVA)	590	125	330	410	75
Rated voltage (kV)	22	15.5	20	24	13.8
Rated pf	0.95	0.85	0.9	0.9	0.8
H (s)	2.319	4.768	3.006	3.704	6.187
D	2.000	2	2.000	2.000	2.000
r_a (p.u)	0.0046	0.004	0.000	0.0019	0.0031
x_d (p.u)	2.110	1.220	1.950	1.7668	1.050
x_q (p.u)	2.020	1.160	1.920	1.7469	0.980
x'_d (p.u)	0.280	0.174	0.317	0.2738	0.185
x'_q (p.u)	0.490	0.250	1.120	1.0104	0.360
x''_d (p.u)	0.215	0.134	0.200	0.2284	0.130
x''_q (p.u)	0.215	0.134	0.200	0.2284	0.130
x_l or x_p (p.u)	0.155	0.0078	0.199	0.1834	0.070
T'_{d0} (s)	0.5573	8.970	0.9754	0.8418	1.0748
T'_{q0} (s)	0.1371	0.500	0.875	0.8676	0.1102
T''_{d0} (s)	0.0246	0.033	0.0473	0.035	0.0267
T''_{q0} (s)	0.0272	0.070	0.0134	0.035	0.0358
$S(1.0)$	0.079	0.1026	0.082	0.2632	0.100
$S(1.2)$	0.349	0.432	0.290	0.5351	0.3928

TABLE I(2)
IEEE 118-BUS MODIFIED TEST SYSTEM GENERATOR DATA

Type	GENROU	GENROU	GENROU	GENROU
Operation	Sync. Gen.	Sync. Gen.	Sync. Gen.	Sync. Gen.
Default Unit no.	54(126)	59(127)	65(129)	
(New Unit no.)	103(136)	61(128)	66(130)	89(134)
	111(137)			
Rated power (MVA)	100	233	512	835
Rated voltage (kV)	13.8	20	24	20
Rated pf	0.8	0.85	0.9	0.9
H (s)	4.985	4.122	2.631	2.6419
D	2.000	2.000	2.000	2.00
r_a (p.u)	0.0035	0.0016	0.004	0.0019
x_d (p.u)	1.180	1.569	1.700	2.183
x_q (p.u)	1.050	1.548	1.650	2.157
x'_d (p.u)	0.220	0.324	0.270	0.413
x'_q (p.u)	0.380	0.918	0.470	1.285
x''_d (p.u)	0.145	0.249	0.200	0.339

x''_q (p.u)	0.145	0.249	0.200	0.339
x_l or x_p (p.u)	0.075	0.204	0.160	0.246
T'_{d0} (s)	1.100	1.0614	0.6035	5.690
T'_{q0} (s)	0.1086	0.8895	0.1367	1.500
T''_{d0} (s)	0.0277	0.0336	0.0556	0.041
T''_{q0} (s)	0.0351	0.0381	0.0319	0.144
$S(1.0)$	0.0933	0.0987	0.090	0.134
$S(1.2)$	0.4044	0.303	0.400	0.617

TABLE II (1)
IEEE 118-BUS MODIFIED TEST SYSTEM CONDENSERS AND MOTORS DATA

Type Operation	GENROU Condenser	GENROU Condenser	GENROU Motor	GENROU Motor
Default Unit no. (New Unit no.)	1(138), 6(139), 15(140), 19(142) 32(143), 34(144), 36(145), 55(146) 56(147), 62(148), 74(150), 76(151) 77(152), 85(153), 92(154) 104(155), 105(156), 110(157)	18(141) 70(149)	4(158) 24(160) 27(161) 72(164) 73(165)	8(159) 91(167) 107(169)
Rated power (MVA)	25	40	25	35.29
Rated voltage (kV)	13.8	13.8	13.8	13.8
Rated pf	0.0	0.0	0.8	0.85
H (s)	1.200	1.520	5.016	4.4893
D	0.000	0.000	2.000	2.000
r_a (p.u)	0.0025	0.000	0.0014	0.000
x_d (p.u)	1.769	2.373	1.250	1.400
x_q (p.u)	0.855	1.172	1.220	1.372
x'_d (p.u)	0.304	0.343	0.232	0.231
x'_q (p.u)	0.5795	1.172	0.715	0.060
x''_d (p.u)	0.2035	0.231	0.120	0.050
x''_q (p.u)	0.2035	0.231	0.120	0.050
x_l or x_p (p.u)	0.1045	0.132	0.114	0.000
T'_{d0} (s)	8.000	11.600	4.750	5.500
T'_{q0} (s)	0.008	0.159	1.500	0.008
T''_{d0} (s)	0.0525	0.058	0.0035	0.008
T''_{q0} (s)	0.0151	0.201	0.210	0.008
$S(1.0)$	0.304	0.295	0.279	0.210
$S(1.2)$	0.666	0.776	0.886	0.805

TABLE II (2)
IEEE 118-BUS MODIFIED TEST SYSTEM CONDENSER AND MOTOR DATA

Type	GENROU	GENROU	GENROU	GENROU
Operation	Motor	Motor	Motor	Motor
Default Unit no.	40(162)	42(163)	90(166)	116(172)
(New Unit no.)	113(171)	99(168)	112(170)	
Rated power (MVA)	51.2	75	100	384
Rated voltage (kV)	13.8	13.8	13.8	24
Rated pf	0.8	0.8	0.8	0.85
H (s)	5.078	6.186	4.985	2.621
D	2.000	2.000	2.000	2.000
r_a (p.u)	0.000	0.000	0.000	0.000
x_d (p.u)	1.270	1.050	1.180	1.798
x_q (p.u)	1.240	0.980	1.050	1.778
x'_d (p.u)	0.209	0.185	0.220	0.324
x'_q (p.u)	0.850	0.360	0.380	1.051
x''_d (p.u)	0.105	0.130	0.145	0.260
x''_q (p.u)	0.105	0.130	0.145	0.260
x_l or x_p (p.u)	0.104	0.070	0.075	0.193
T'_{d0} (s)	6.600	6.100	5.900	5.210
T'_{q0} (s)	0.008	0.300	0.300	1.500
T''_{d0} (s)	0.008	0.038	0.038	0.042
T''_{q0} (s)	0.008	0.099	0.092	0.042
$S(1.0)$	0.2067	0.100	0.0933	0.162
$S(1.2)$	0.724	0.3928	0.4044	0.508

TABLE III (1)
IEEE 118-BUS MODIFIED TEST SYSTEM EXCITER DATA FOR GENERATORS

Type	IEEET1	IEEET1	IEEET1	IEEET1	IEEET1
Default Unit no.	10(119)		25(121)		31(123)
(New Unit no.)	69(131)	12(120)	49(125)	26(122)	46(124)
	80(132)		100(135)		87(133)
Rated power (MVA)	590	125	330	410	75
Rated voltage (kV)	22	15.5	20	24	13.8
T_r (s)	0.000	0.060	0.000	0.000	0.000
K_a (p.u)	200	25	400	400	0.050
T_a (s)	0.3575	0.200	0.050	0.020	20.000
V_{Rmax} (p.u)	5.730	1.000	3.810	5.270	4.380
V_{Rmin} (p.u)	-5.730	-1.000	-3.810	-5.270	0.000
K_e (p.u)	1.000	-0.0601	-0.170	1.000	1.000
T_e (s)	0.011	0.6758	0.950	0.920	1.980
K_f (p.u)	0.0529	0.108	0.040	0.030	0.000
T_f	1.000	0.350	1.000	1.000	0.100
E_1	4.2975	2.4975	3.6675	2.4675	2.385
$SE(E_1)$	0.000	0.0949	0.0111	0.4351	0.0951
E_2	5.730	3.330	4.890	3.290	3.180
$SE(E_2)$	0.000	0.37026	0.0178	0.6001	0.3712

TABLE III (2)
IEEE 118-BUS MODIFIED TEST SYSTEM EXCITER DATA FOR GENERATORS

Type	IEEET1	IEEET1	IEEET1	IEEET1
Default Unit no. (New Unit no.)	54(126) 103(136) 111(137)	59(127) 61(128)	65(129) 66(130)	89(134)
Rated power (MVA)	100	233	512	835
Rated voltage (kV)	13.8	20	24	20
T_r (s)	0.060	0.000	0.000	0.000
K_a (p.u)	25	250	200	400
T_a (s)	0.200	0.060	0.395	0.020
V_{Rmax} (p.u)	1.000	4.420	3.840	18.300
V_{Rmin} (p.u)	-1.000	-4.420	-3.840	-18.300
K_e (p.u)	-0.0582	1.000	1.000	1.000
T_e (s)	0.6544	0.613	0.008	0.942
K_f (p.u)	0.105	0.053	0.0635	0.030
T_f	0.350	0.330	1.000	1.000
E_1	2.5785	2.610	2.880	3.765
$SE(E_1)$	0.0889	0.000	0.000	0.8147
E_2	3.438	3.480	3.840	5.020
$SE(E_2)$	0.3468	0.000	0.000	2.6756

TABLE IV (1)
IEEE 118-BUS MODIFIED TEST SYSTEM EXCITER DATA FOR CONDENSERS AND MOTORS

Type	IEEET1	IEEET1	IEEET1	IEEET1
Default Unit no. (New Unit no.)	1(138), 6(139) 15(140), 19(142) 32(143), 34(144) 36(145), 55(146) 56(147), 62(148) 74(150), 76(151) 77(152), 85(153) 92(154), 104(155) 105(156), 110(157)	18(141) 70(149)	4(158), 24(160) 27(161), 72(164) 73(165)	8(159) 91(167) 107(169)
Rated power (MVA)	25	40	25	35.29
Rated voltage (kV)	13.8	13.8	13.8	13.8
T_r (s)	0.000	0.000	0.000	0.000
K_a (p.u)	400	400	0.050	57.140
T_a (s)	0.050	0.050	20.000	0.050
V_{Rmax} (p.u)	4.407	6.630	6.812	1.000
V_{Rmin} (p.u)	-4.407	-6.630	1.395	-1.000
K_e (p.u)	-0.170	-0.170	1.000	-0.0445
T_e (s)	0.950	0.950	0.700	0.500
K_f (p.u)	0.040	0.040	0.000	0.080
T_f	1.000	1.000	0.008	1.000

E_1	4.2375	6.375	2.6753	3.375
$SE(E_1)$	0.2174	0.2174	0.4135	0.0711
E_2	5.650	8.500	3.567	4.500
$SE(E_2)$	0.9386	0.9388	0.907	0.2774

TABLE IV (2)
IEEE 118-BUS MODIFIED TEST SYSTEM EXCITER DATA FOR CONDENSERS AND MOTORS

Type	IEEET1	IEEET1	IEEET1	IEEET1
Default Unit no.	40(162)	42(163)	90(166)	116(172)
(New Unit no.)	113(171)	99(168)	112(170)	
Rated power (MVA)	51.2	75	100	384
Rated voltage (kV)	13.8	13.8	13.8	24
T_r (s)	0.000	0.000	0.060	0.000
K_a (p.u)	400	0.050	25	400
T_a (s)	0.050	20.000	0.200	0.020
V_{Rmax} (p.u)	0.613	4.380	1.000	8.130
V_{Rmin} (p.u)	-0.613	0.000	-1.000	-8.130
K_e (p.u)	-0.0769	1.000	-0.0582	1.000
T_e (s)	1.370	1.980	0.6544	0.812
K_f (p.u)	0.040	0.000	0.105	0.060
T_f	1.000	0.008	0.350	1.000
E_1	3.0975	2.385	2.5785	3.6825
$SE(E_1)$	0.1117	0.0951	0.0889	0.4589
E_2	4.130	3.180	3.438	4.910
$SE(E_2)$	0.2248	0.3712	0.3468	0.6558

TABLE V (1)
IEEE 118-BUS MODIFIED TEST SYSTEM GOVERNOR DATA FOR GENERATORS

Type	BPA_GG	BPA_GG	BPA_GG	BPA_GG	BPA_GG
Default Unit no.	10(119)		25(121)		31(123)
(New Unit no.)	69(131)	12(120)	49(125)	26(122)	46(124)
	80(132)		100(135)		87(133)
Rated power (MVA)	590	125	330	410	75
Rated voltage (kV)	22	15.5	20	24	13.8
P_{max} (p.u)	0.9372	1.056	1.050	0.8951	1.000
R (p.u)	0.0085	0.040	0.0152	0.0122	0.066
T_1 (s)	0.080	0.083	0.100	0.180	0.090
T_2 (s)	0.000	0.000	0.000	0.000	0.000
T_3 (s)	0.150	0.200	0.400	0.040	0.200
T_4 (s)	0.050	0.050	0.050	0.250	0.300
T_5 (s)	10.000	5.000	8.000	8.000	0.000
F	0.280	0.280	0.250	0.267	1.000

TABLE V (2)
IEEE 118-BUS MODIFIED TEST SYSTEM GOVERNOR DATA FOR GENERATORS

Type	BPA_GG	BPA_GG	BPA_GG	BPA_GG
Default Unit no. (New Unit no.)	54(126) 103(136) 111(137)	59(127) 61(128)	65(129) 66(130)	89(134)
Rated power (MVA)	100	233	512	835
Rated voltage (kV)	13.8	20	24	20
P_{max} (p.u)	1.050	0.901	0.898	0.9177
R (p.u)	0.050	0.0214	0.0098	0.006
T_1 (s)	0.090	0.150	0.150	0.180
T_2 (s)	0.000	0.000	0.050	0.030
T_3 (s)	0.200	0.100	0.300	0.200
T_4 (s)	0.300	0.300	0.260	0.000
T_5 (s)	0.000	10.000	8.000	8.000
F	1.000	0.237	0.270	0.300