

# IEEE 9-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  
IEEE 9-BUS MODIFIED TEST SYSTEM MACHINE DATA

Type	GENROU	GENROU	GENROU
Operation	Sync. Gen.	Sync. Gen.	Sync. Gen.
Default Unit no. (New Unit no.)	1(12)	2(10)	3(11)
Rated power (MVA)	512	270	125
Rated voltage (kV)	24	18	15.5
Rated pf	0.9	0.85	0.85
$H$ (s)	2.6312	4.1296	4.768
$D$	2.000	2.000	2
$r_a$ (p.u)	0.004	0.0016	0.004
$x_d$ (p.u)	1.700	1.700	1.220
$x_q$ (p.u)	1.650	1.620	1.160
$x'_d$ (p.u)	0.270	0.256	0.174
$x'_q$ (p.u)	0.470	0.245	0.250
$x''_d$ (p.u)	0.200	0.185	0.134
$x''_q$ (p.u)	0.200	0.185	0.134
$x_l$ or $x_p$ (p.u)	0.160	0.155	0.0078
$T'_{d0}$ (s)	3.800	4.800	8.970
$T'_{q0}$ (s)	0.480	0.500	0.500
$T''_{d0}$ (s)	0.010	0.010	0.033
$T''_{q0}$ (s)	0.0007	0.0007	0.070
$S(1.0)$	0.090	0.125	0.1026
$S(1.2)$	0.400	0.450	0.432

TABLE II  
IEEE 9-BUS MODIFIED TEST SYSTEM EXCITER DATA

Type	IEEET1	IEEET1	IEEET1
Default Unit no. (New Unit no.)	1(12)	2(10)	3(11)
Rated power (MVA)	512	270	125
Rated voltage (kV)	24	18	15.5
$T_r$ (s)	0.000	0.000	0.060
$K_a$ (p.u)	200	30	25
$T_a$ (s)	0.395	0.400	0.200
$V_{Rmax}$ (p.u)	3.840	4.590	1.000
$V_{Rmin}$ (p.u)	-3.840	-4.590	-1.000
$K_e$ (p.u)	1.000	-0.020	-0.0601
$T_e$ (s)	0.000	0.560	0.6758
$K_f$ (p.u)	0.0635	0.050	0.108
$T_f$ (s)	1.000	1.300	0.350
$E_1$ (p.u)	2.880	2.5875	2.4975
$SE(E_1)$	0.000	0.7298	0.0949
$E_2$ (p.u)	3.840	3.450	3.330
$SE(E_2)$	0.000	1.3496	0.37026

TABLE III  
IEEE 9-BUS MODIFIED TEST SYSTEM GOVERNOR DATA

Type	BPA_GG	BPA_GG	BPA_GG
Default Unit no. (New Unit no.)	1(12)	2(10)	3(11)
Rated power (MVA)	512	270	125
Rated voltage (kV)	24	18	15.5
$P_{max}$ (p.u)	0.8984	0.8518	1.056
$R$ (p.u)	0.00976	0.01852	0.040
$T_1$ (s)	0.150	0.100	0.083
$T_2$ (s)	0.050	0.000	0.000
$T_3$ (s)	0.300	0.259	0.200
$T_4$ (s)	0.260	0.100	0.050
$T_5$ (s)	8.000	10.000	5.000
$F$	0.270	0.272	0.280