

ANEXO 1.

DATOS TÉCNICOS DE LOS 8 GENERADORES DE LA CENTRAL HIDROELÉCTRICA DE SAN CARLOS

PARÁMETRO GENERADOR	UNIDAD	VALOR INICIAL (FORMULARIO)
Denominación	-	Turbina
Fabricante	-	Toshiba
Modelo	-	2KD003709
Tipo	-	Polos salientes
Puesta en funcionamiento	Año	1984
Potencia Aparente Nominal	S_n [MVA]	170
Factor de potencia	$\cos(\phi)$	0.95
Tensión de Estator Nominal	U_n [kV]	16.5 +/-5%
Reactancia de Fuga del Estator.	x_l [pu]	0.1
Reactancia sincrónica eje D (no saturado)	x_d [pu]	1.06
Reactancia sincrónica eje Q (no saturado)	x_q [pu]	0.9
Reactancia transiente sincrónica eje D (no saturado)	x_d' [pu]	0.3
Reactancia sub-transiente sincrónica eje D (no saturado)	x_d'' [pu]	0.28
Reactancia de sub-transiente sincrónica eje Q (no saturado)	x_q'' [pu]	0.32
Constante de tiempo transiente (corto circuito) sin carga eje D	T_d' [s]	2.1
Constante de tiempo sub-transiente (corto circuito) sin carga eje D	T_d'' [s]	0.06
Constante de tiempo sub-transiente (corto circuito) sin carga eje Q	T_q'' [s]	1
Constante de inercia (todo el eje incluyendo la turbina)	H [MWs/MVA]	3.2
Factor de saturación a 1.0 p.u. de tensión en el estator (S1.0)	-	0.022
Factor de saturación a 1.2 p.u. tensión en el estator (S1.2)	-	0.23

2.2 Convenciones para el sistema por unidad (p.u.)

• Tensión der generador en V_T	1 p.u. = 16.5 kV
• Corriente de campo del generador I_F	1 p.u. = 855 A
• Tensión de Campo del generador U_F	1 p.u. = 110.6 V
• Tensión de control U_C	1 p.u. = 1.p.u. por p.u. de U_F
• Potencia activa P	1 p.u. = 170 MW
• Potencia reactiva Q	1 p.u. = 170 Mvar
• Corriente der generador I_T	1 p.u. = 5948 A
• Señal estabilizador V_{PSS}	1 p.u. = 1.p.u. por p.u. de V_T

ANEXO 2

DIAGRAMAS DE BLOQUE DE CONTROL DE LAS UNIDADES 1 AL 8 DE SAN CARLOS

Diagrama General Total Generador, Excitación, Limitadores, PSS, Turbinas, conducción.

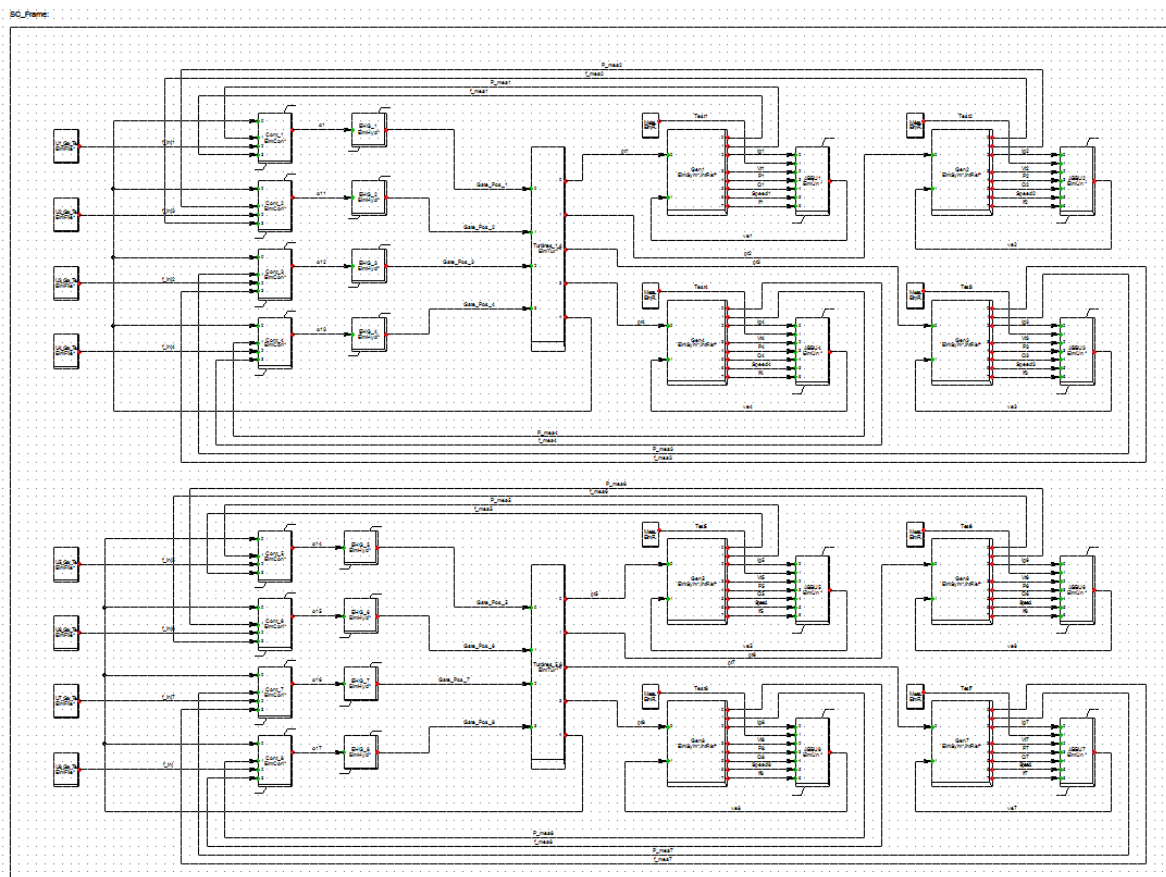
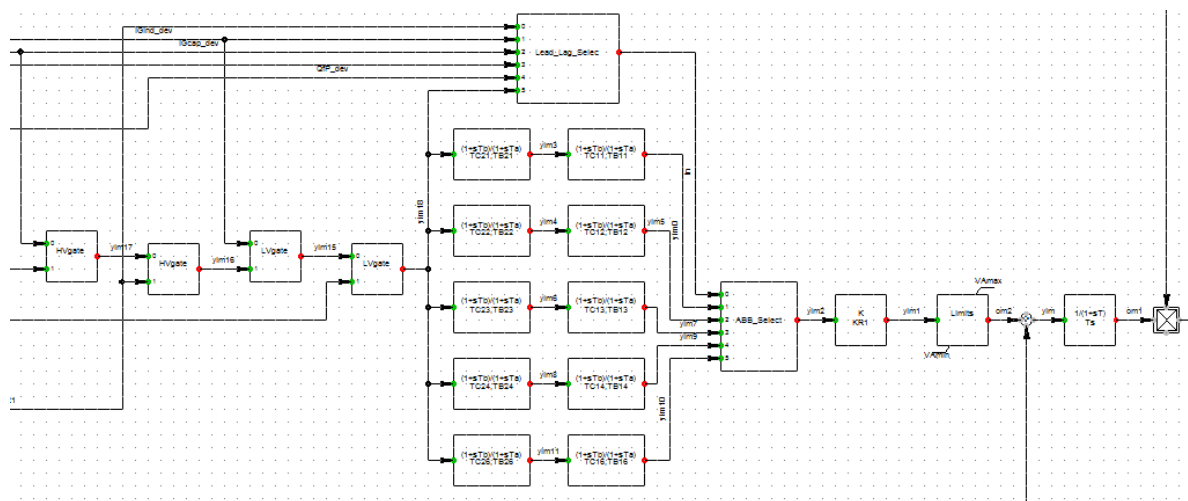
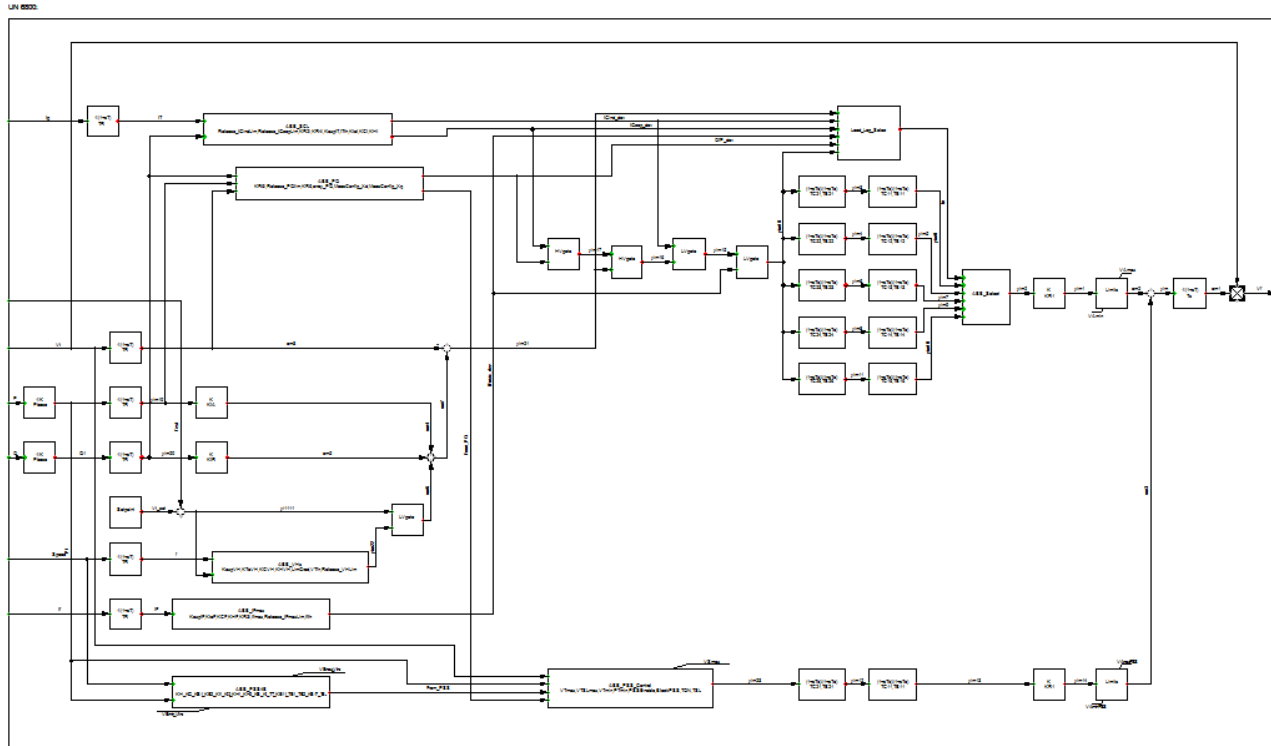


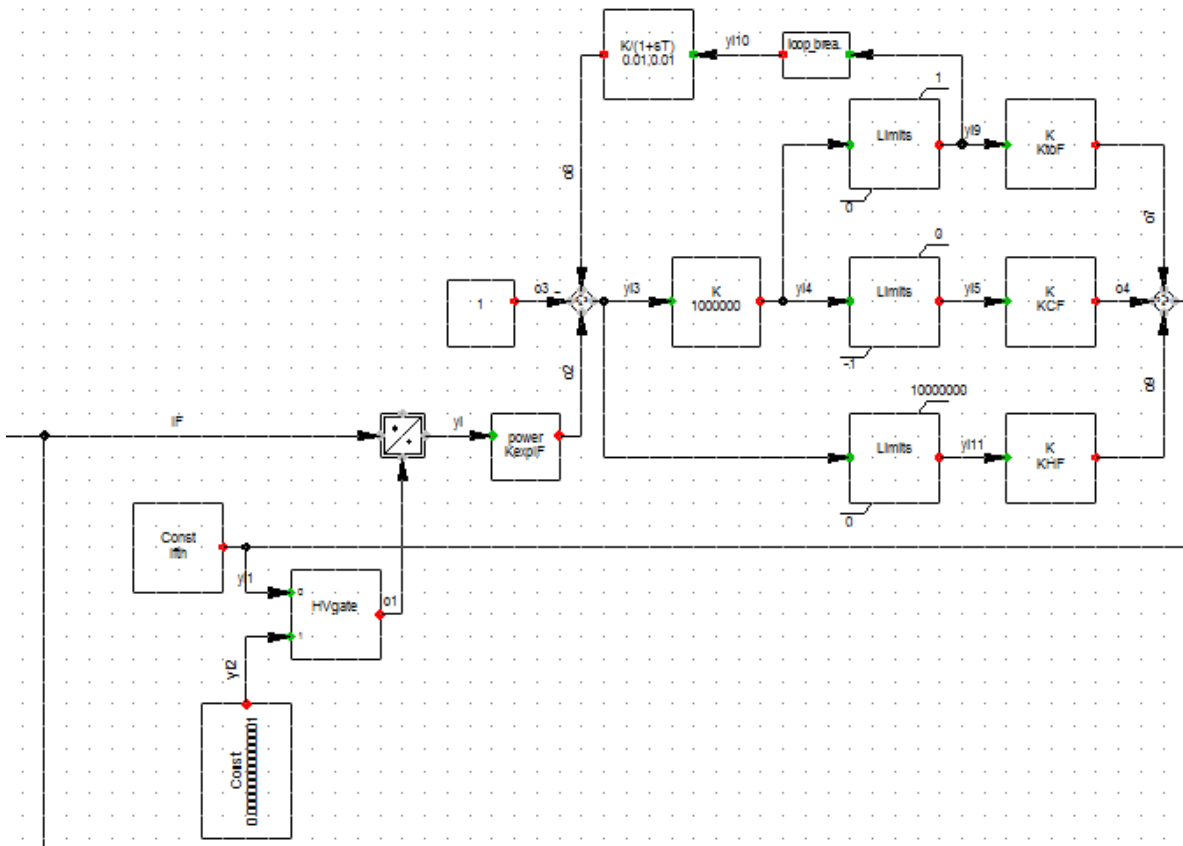
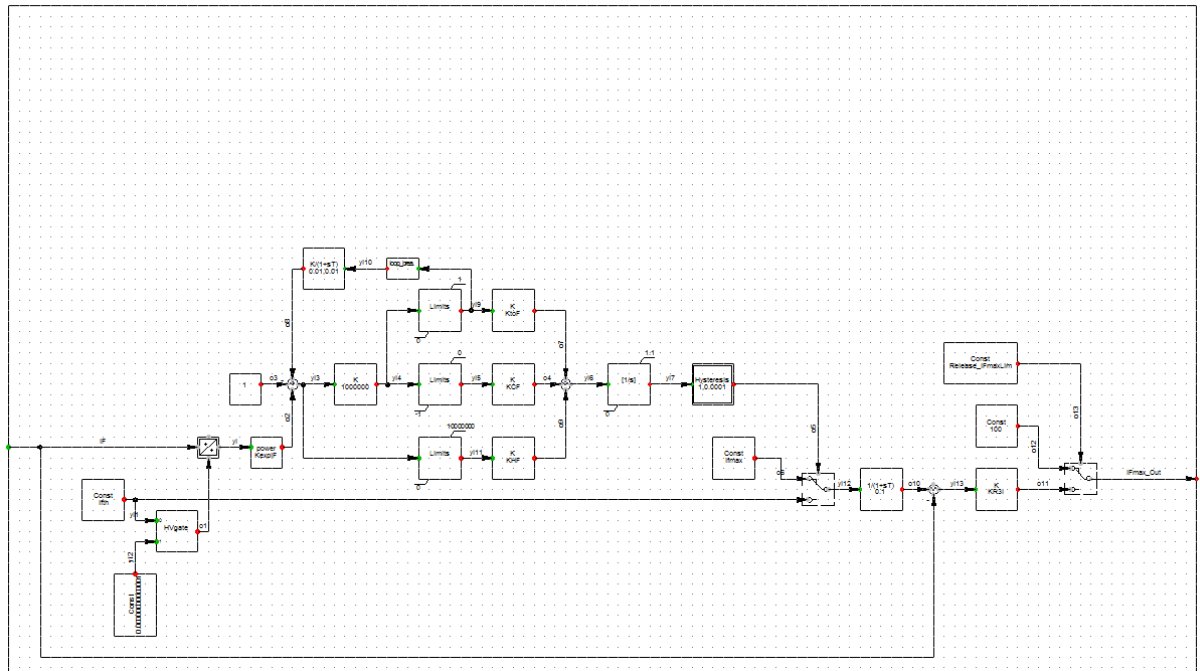
FIGURA 41. DIAGRAMA GENERAL DEL MODELO EN Digsilent.

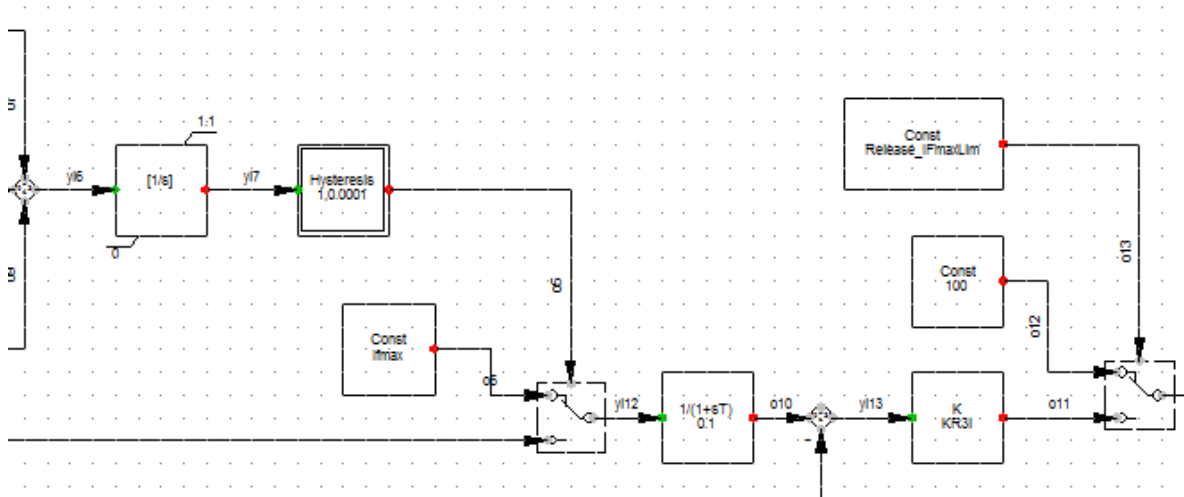
Regulador de tensión (AVR)



Limitador de sobreexcitación, IFmáx, OEL

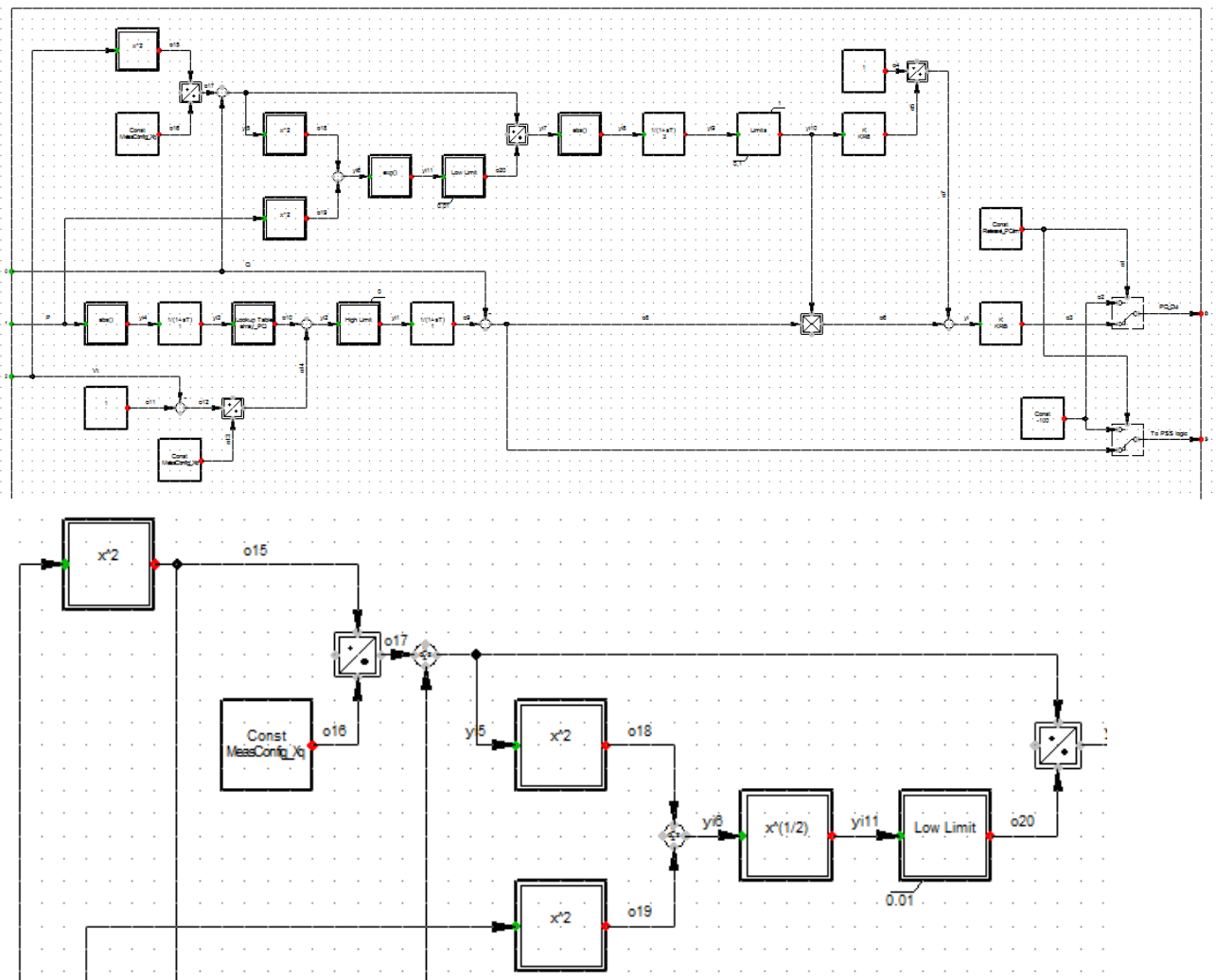
ABB_IFmax

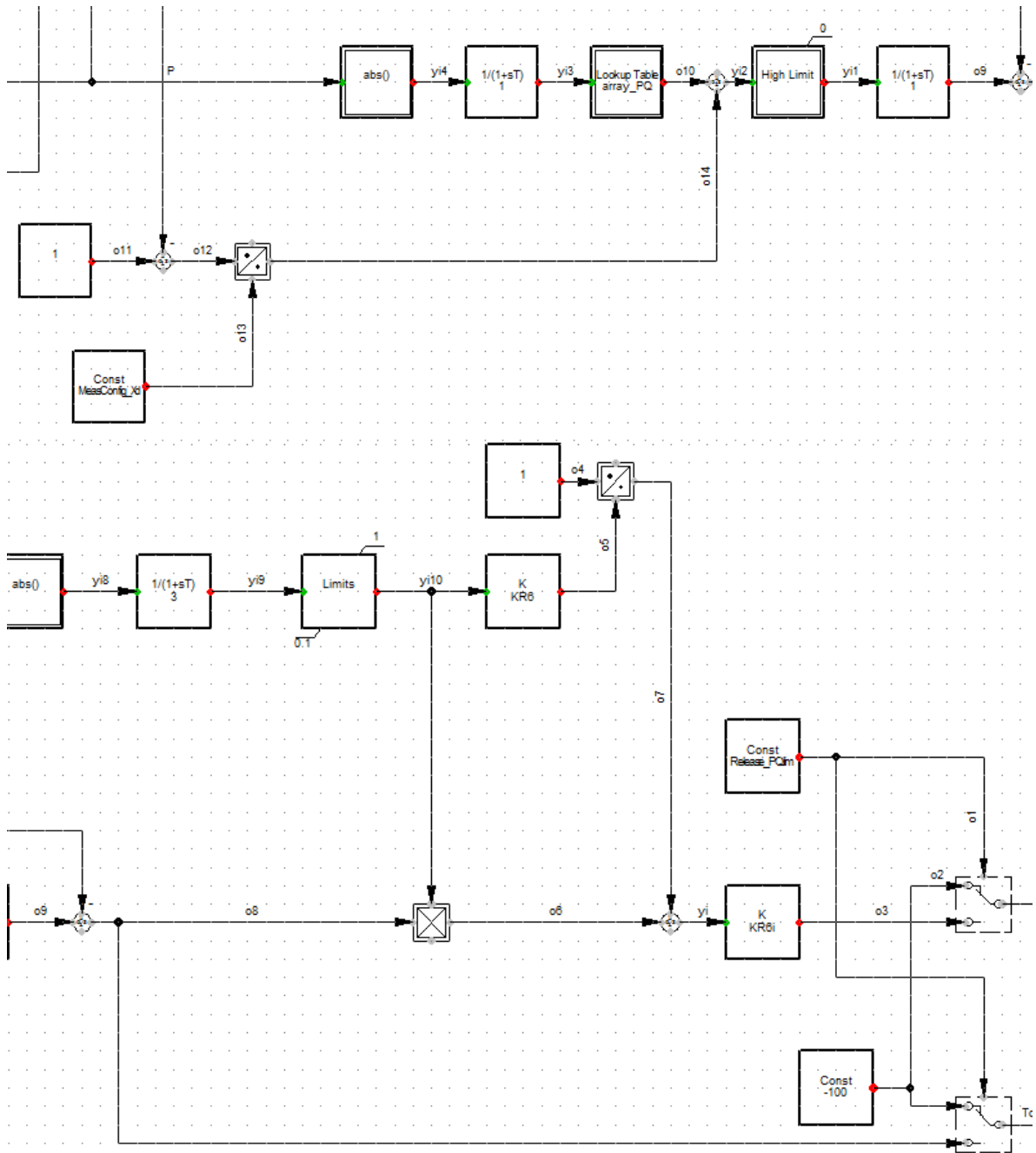




Limitador de Subexcitación, P/Q, UEL

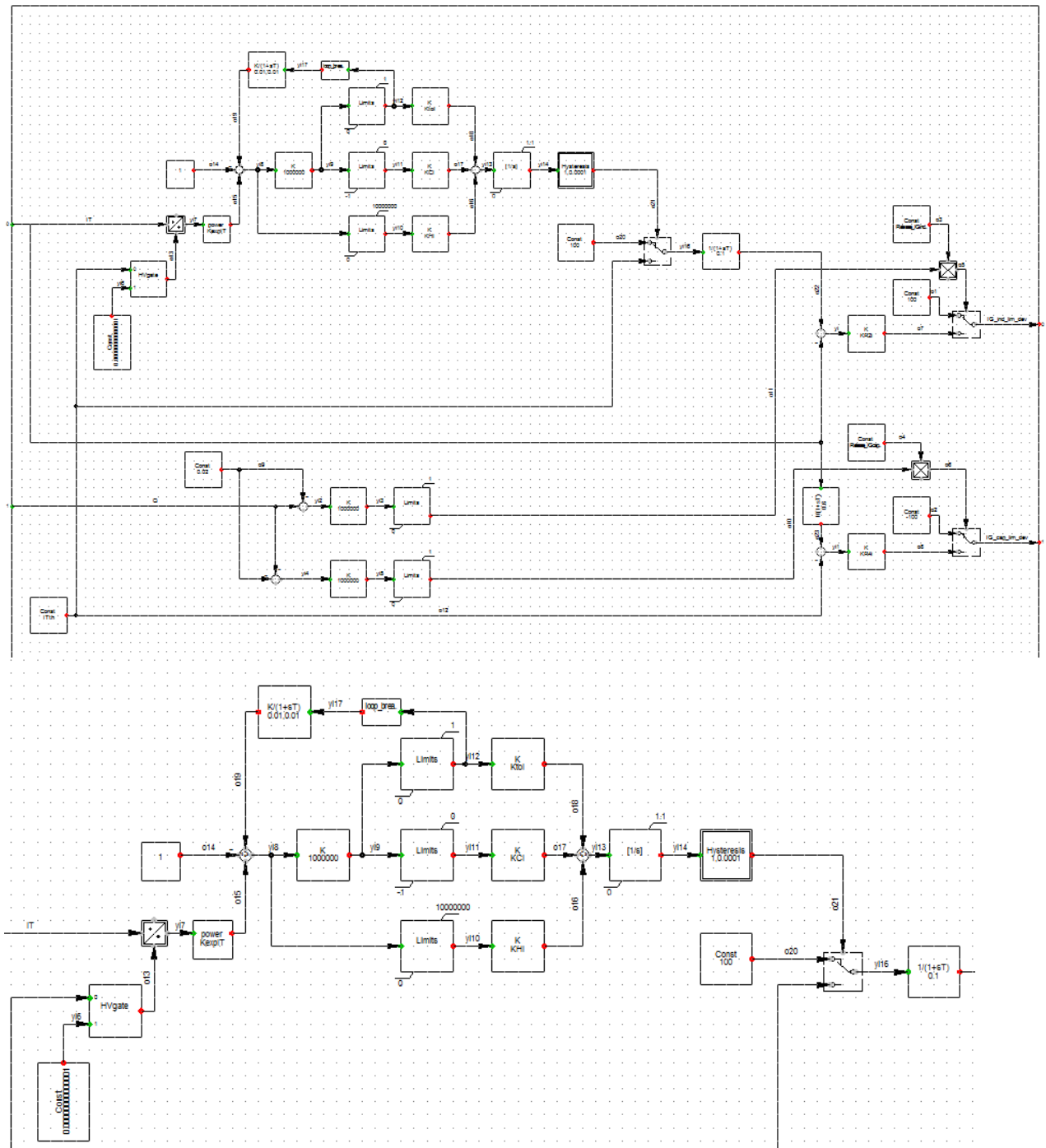
ABB_PO:

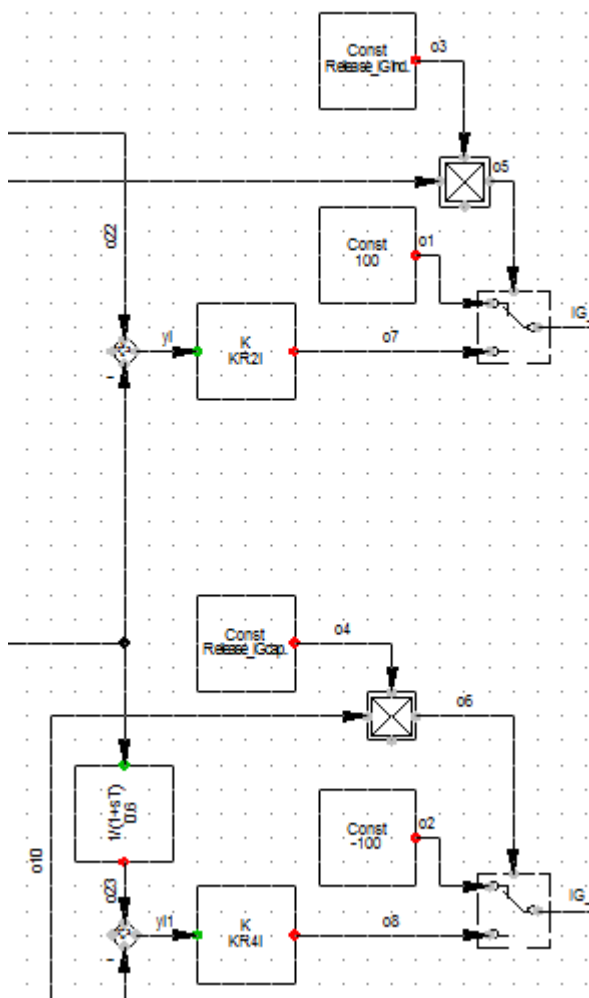
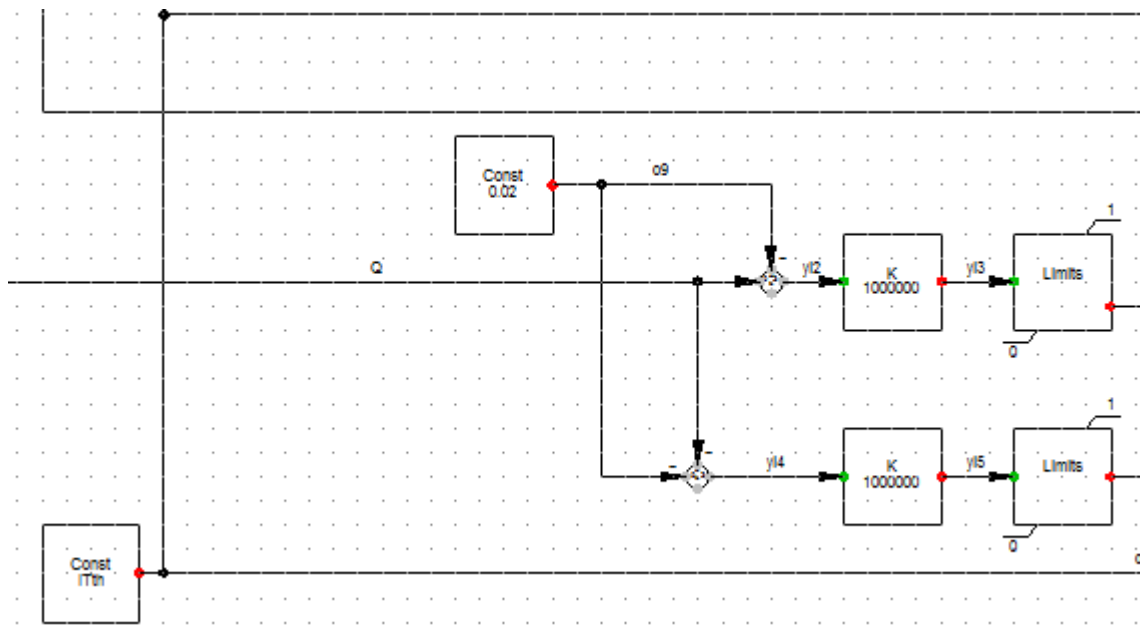




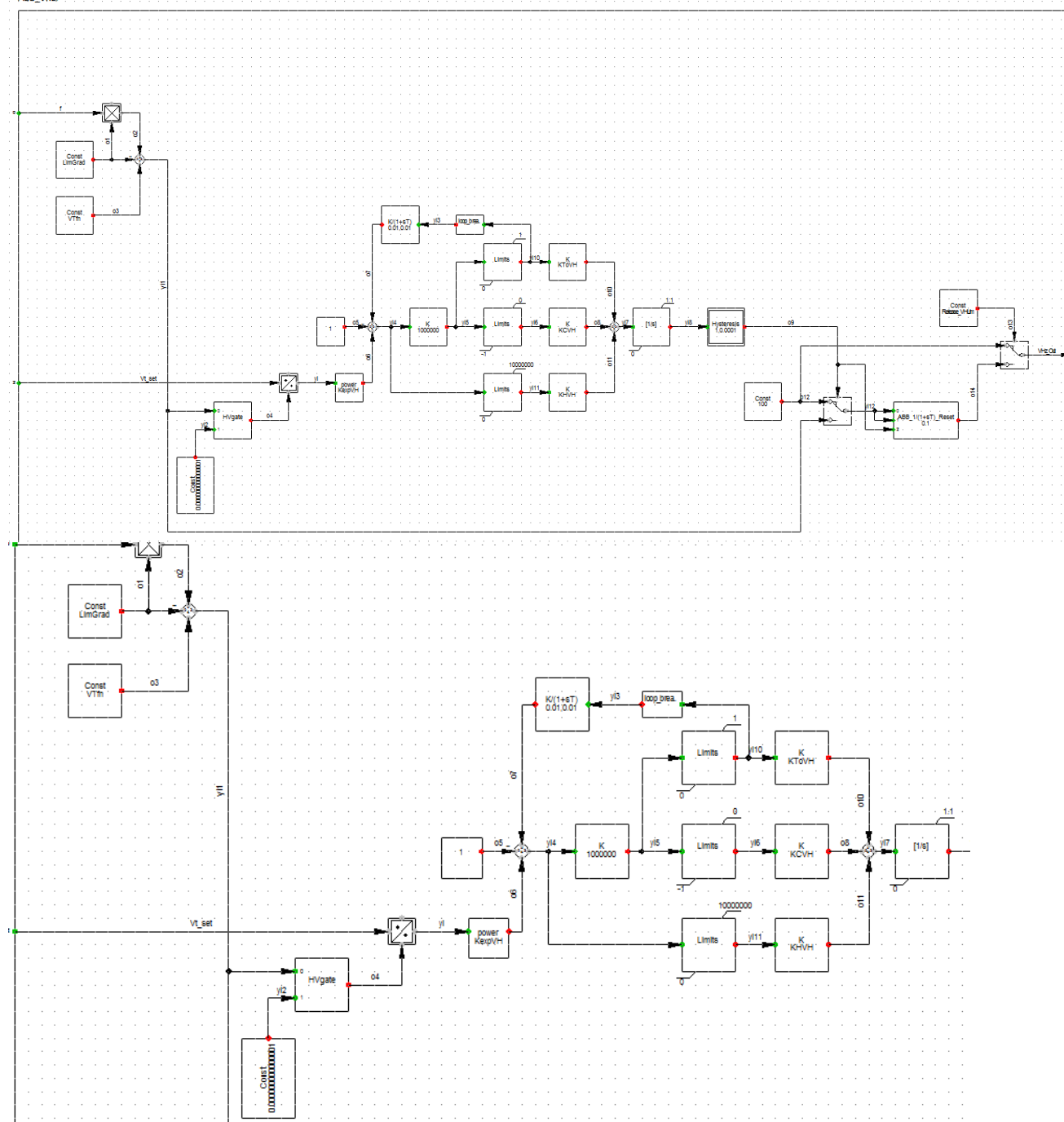
Limitador de máxima corriente estática, SCL

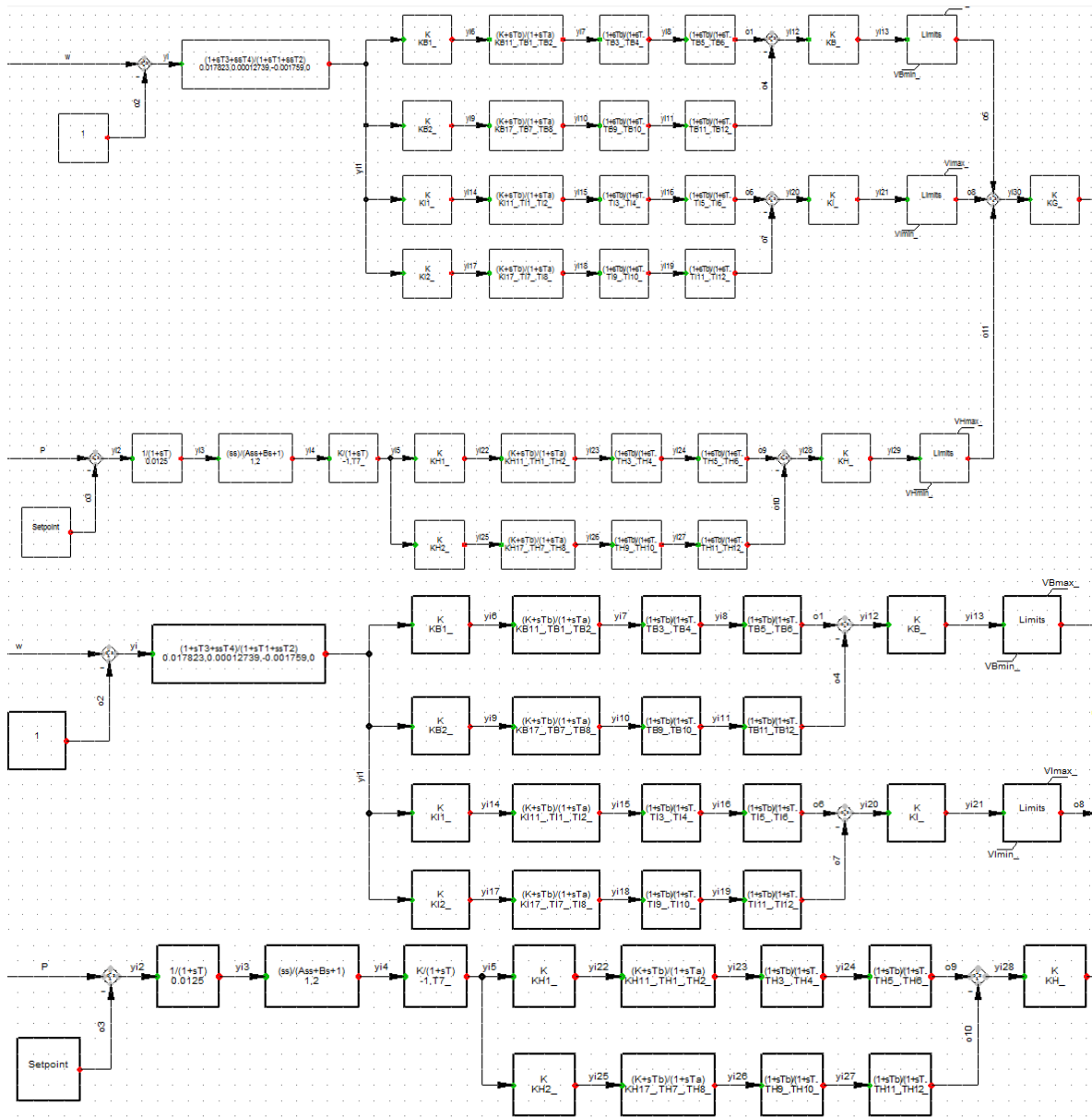
ABB_SCL

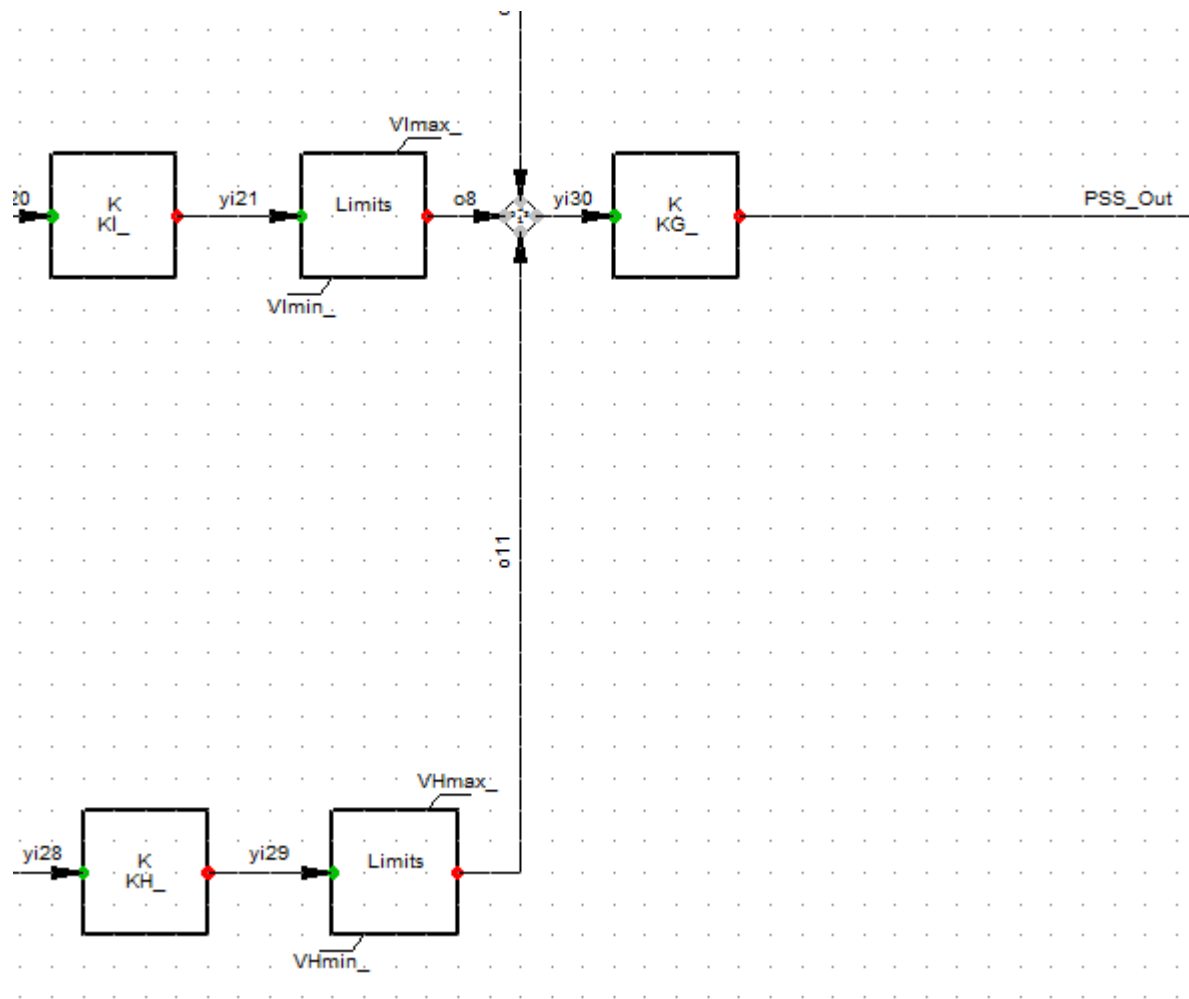


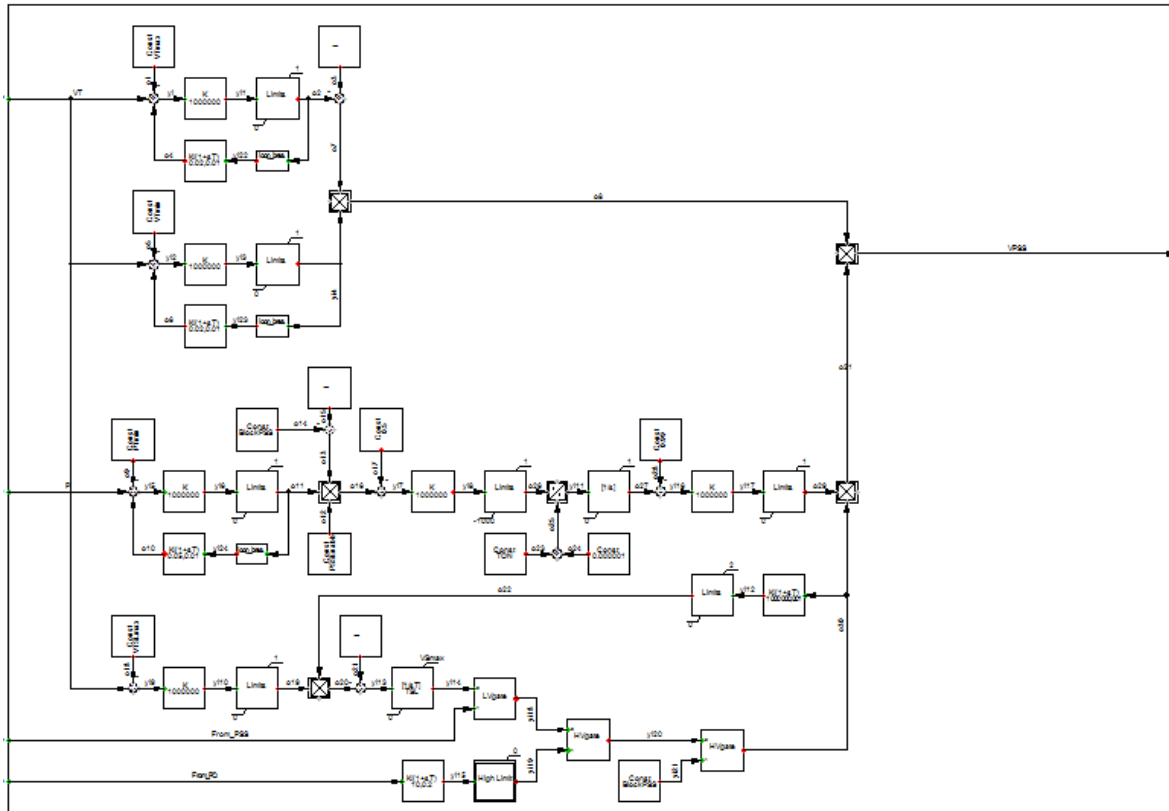


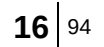
ABB_VHz

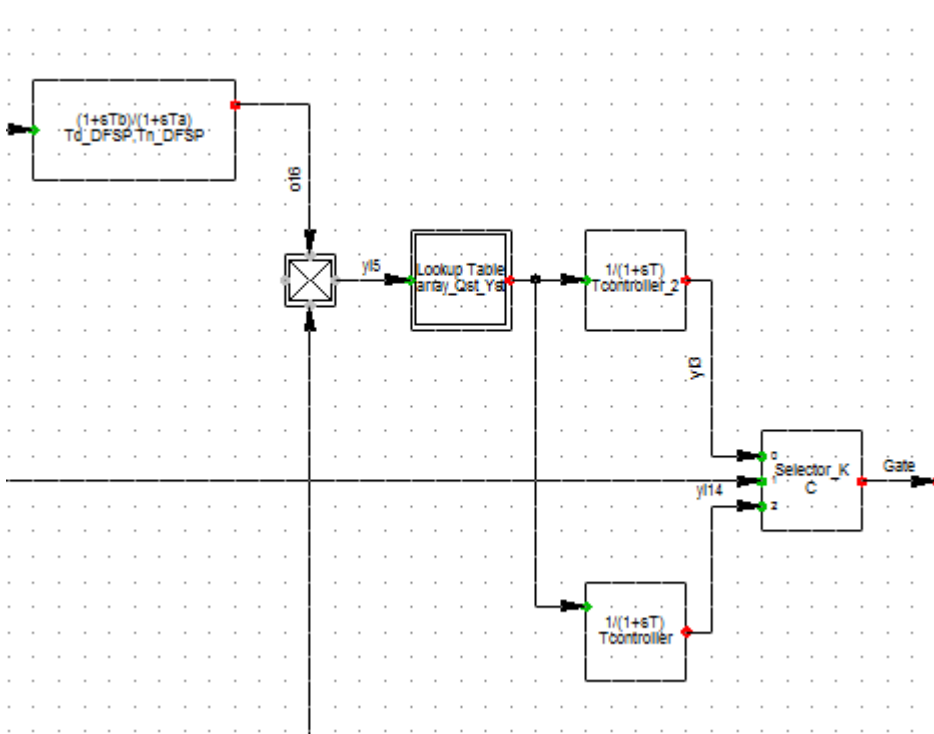
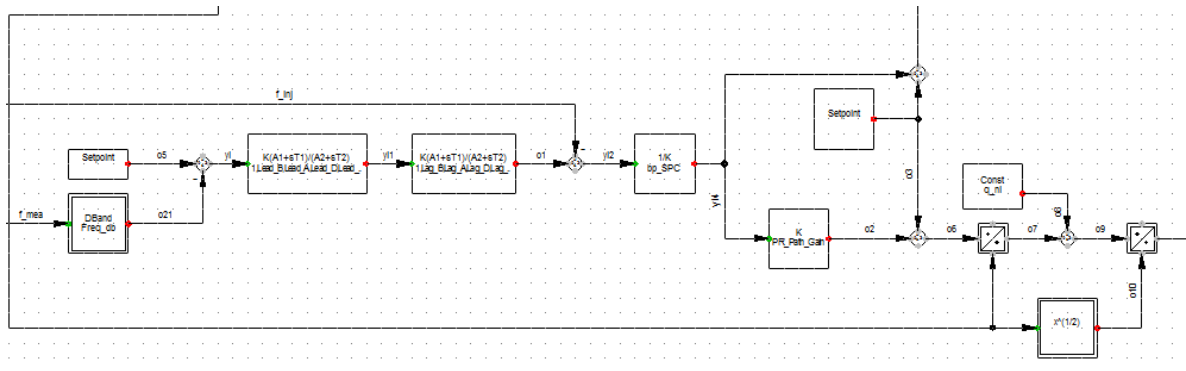
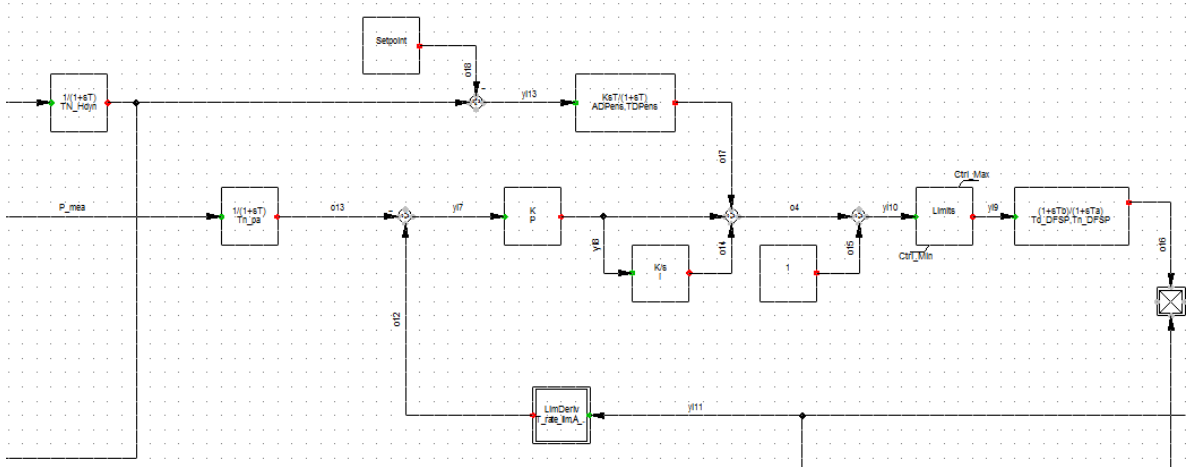












Modelo dControl de Válvulas

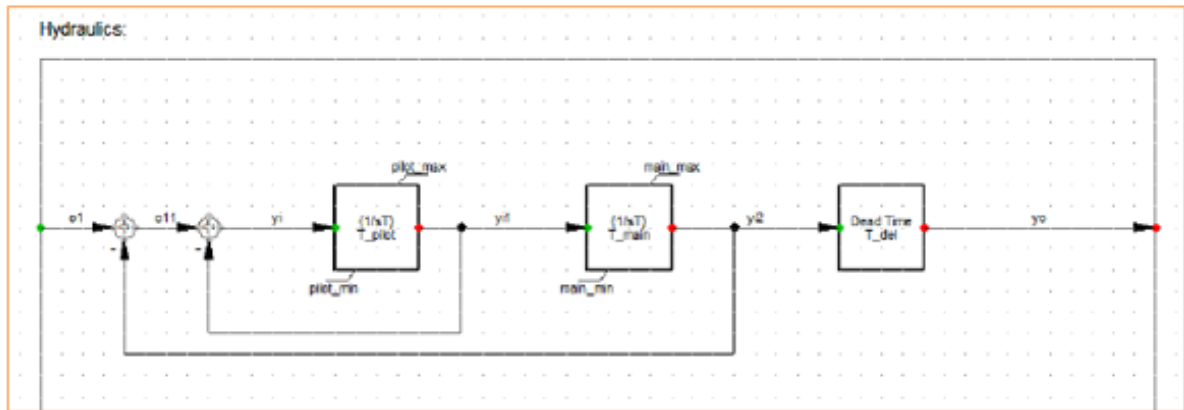
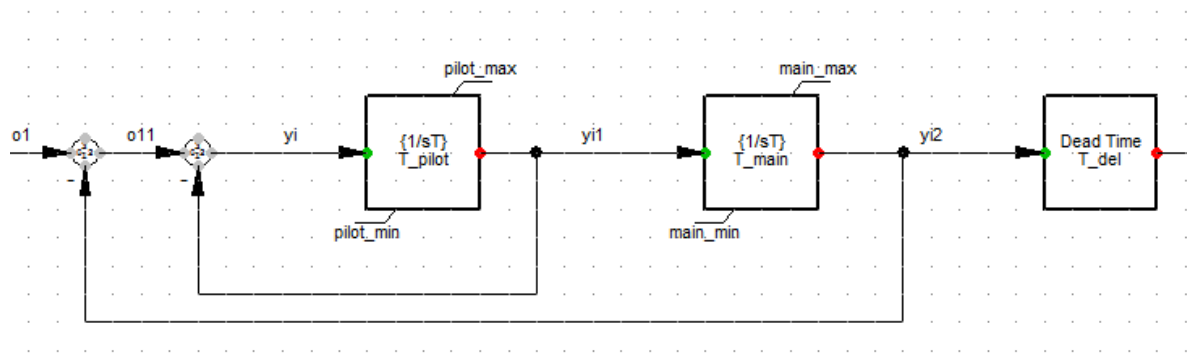
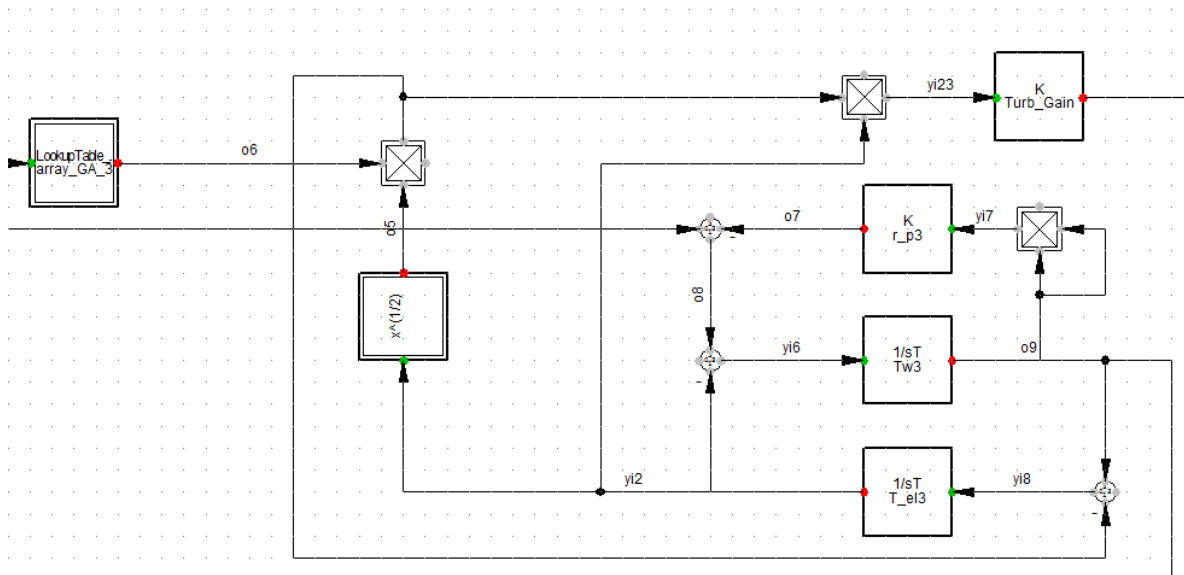
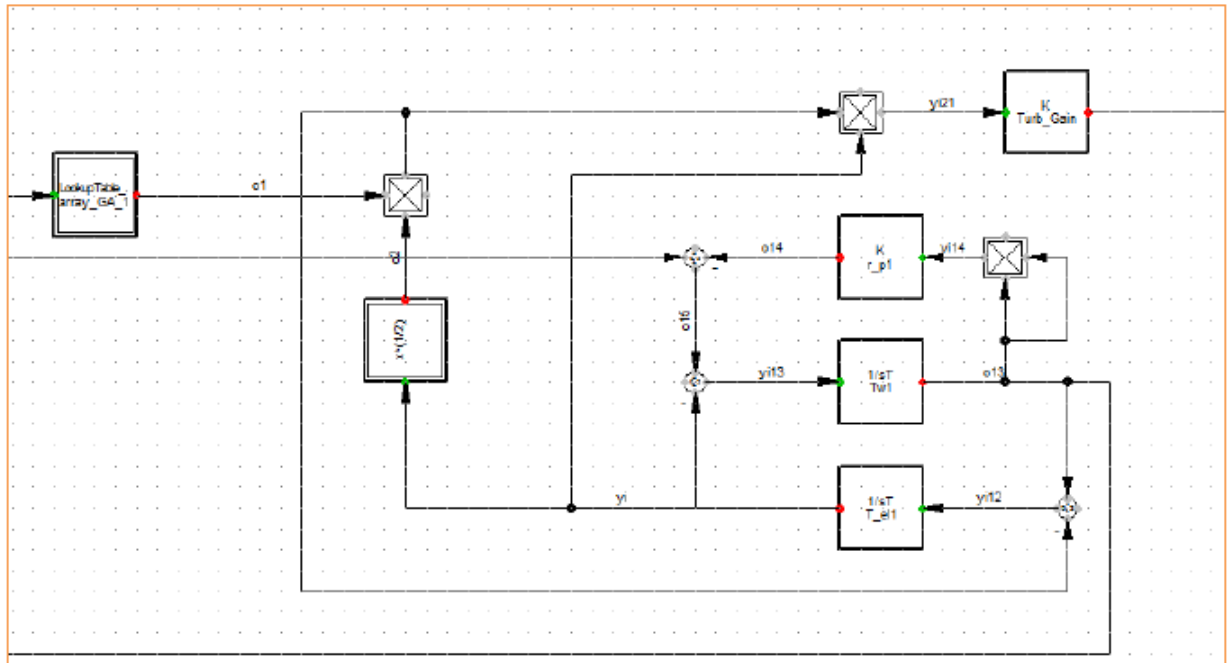


FIGURA 47. MODELO DE CONTROL DE ACTUADOR

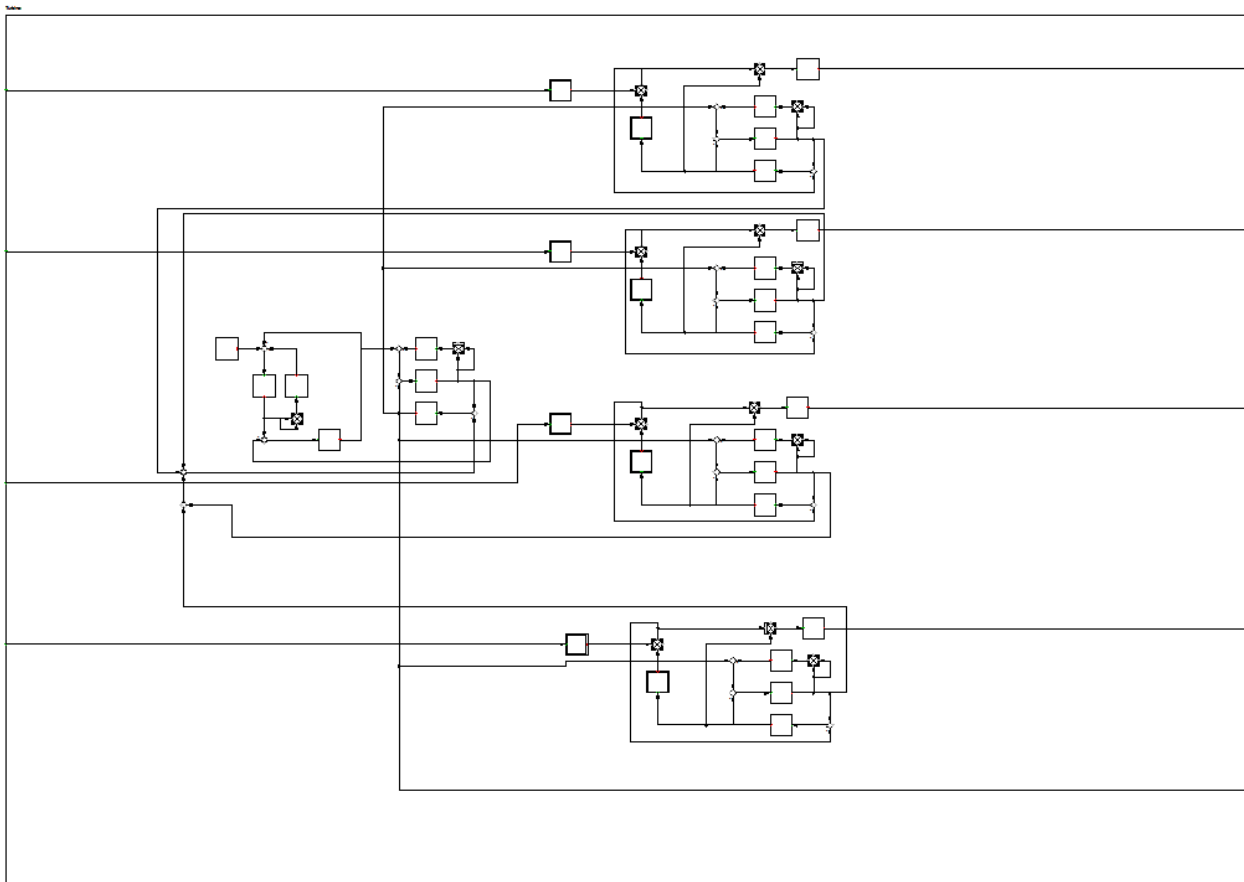


Características De Posición-Flujo Total De Regulación

Modelo turbina y último segmento de conducción



Modelo conjunto de turbinas y conducción



ANEXO 3

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 1 DE SAN CARLOS

Diagrama General Total Generador, Excitación, Limitadores, PSS, Turbinas, conducción.

Sistema de Excitación:

TABLA 2. PARÁMETROS EXCITACIÓN

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U1			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexplT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.8333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexplF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAMin	-6.03	[pu]
AVR output negative ceiling value	VAMinPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAMax	6.85	[pu]
AVR output positive ceiling value	VAMaxPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IF_{máx}, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U1_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.048
P	0.4
PR_Path_Gain	2.8
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U1_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nl	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U1_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.8
Td_DFSP	0.5
Tn_DFSP	5
ADPens	1
TDPens	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U1_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	2
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL— POSICIÓN ACTUADOR

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U1_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U1_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U1_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador Network Model >> Network Data >> Grid >> Hydraulics_1	
Parámetro	Valor
T_pilot	0.8
T_main	1.6
T_del	1
pilot_min	-0.2
main_min	0
pilot_max	0.02
main_max	1.13

Características De Posición-Flujo Total De Regulación

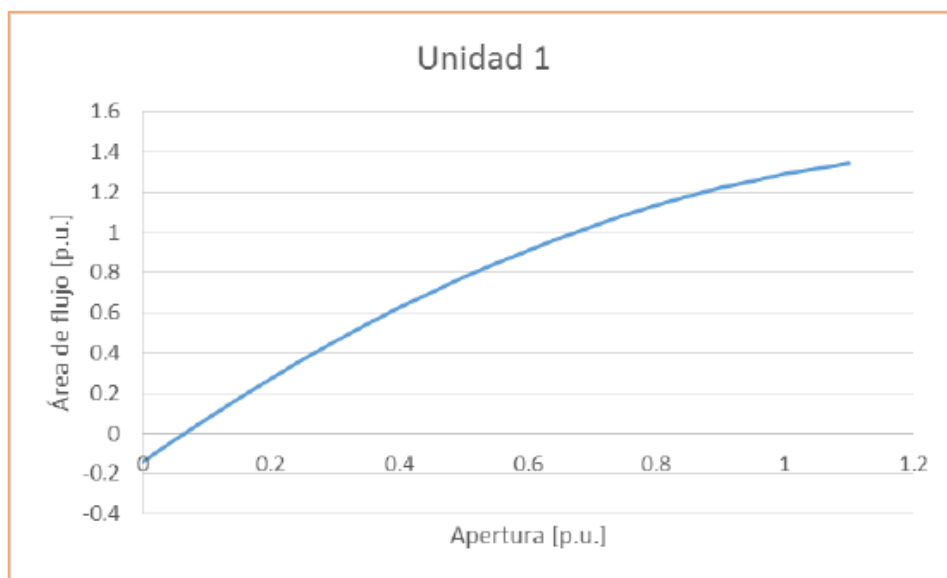


FIGURA 48. CARACTERÍSTICAS DE POSICIÓN ACTUADOR.

TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador		Características de posición – área de flujo del actuador		Características de posición – área de flujo del actuador	
Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_1		Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_1		Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_1	
Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]
0	-0.1441801	0.4	0.6243426	0.85	1.178846
0.05	-0.03392792	0.45	0.7021676	0.9	1.220191
0.1	0.0722709	0.5	0.7759393	0.95	1.257482
0.15	0.1744163	0.55	0.8456576	1	1.290719
0.2	0.2725084	0.6	0.9113225	1.05	1.319904
0.25	0.366547	0.65	0.972934	1.1	1.345035
0.3	0.4565322	0.7	1.030492		
0.35	0.5424641	0.75	1.083997		
		0.8	1.133448		

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_1_4	
Parámetro	Valor
H_st	1
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025
Parámetro	Valor
r_p	0.00175
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_1	Ver Tabla 8

ANEXO 4

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 2 DE SAN CARLOS

Sistema de Excitación:

TABLA 2. PARÁMETROS EXCITACIÓN

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U2			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexpIT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.83333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexpIF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAMin	-6.03	[pu]
AVR output negative ceiling value	VAMinPSS	-3	[pu]
AVR output negative ceiling value	VAMinPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAMax	6.85	[pu]
AVR output positive ceiling value	VAMaxPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IFmáx, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U2_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.0485
P	0.4
PR_Path_Gain	1.8
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U2_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nl	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U2_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.5
Td_DFSP	0.5
Tn_DFSP	5
ADPens	1
TDPens	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U2_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	2
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL– POSICIÓN ACTUADOR

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U2_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U2_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U2_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador	
Network Model >> Network Data >> Grid >> Hydraulics_2	
Parámetro	Valor
T_pilot	0.4
T_main	0.6
T_del	1
pilot_min	-0.02
main_min	0
pilot_max	0.008
main_max	1.08

Características De Posición-Flujo Total De Regulación

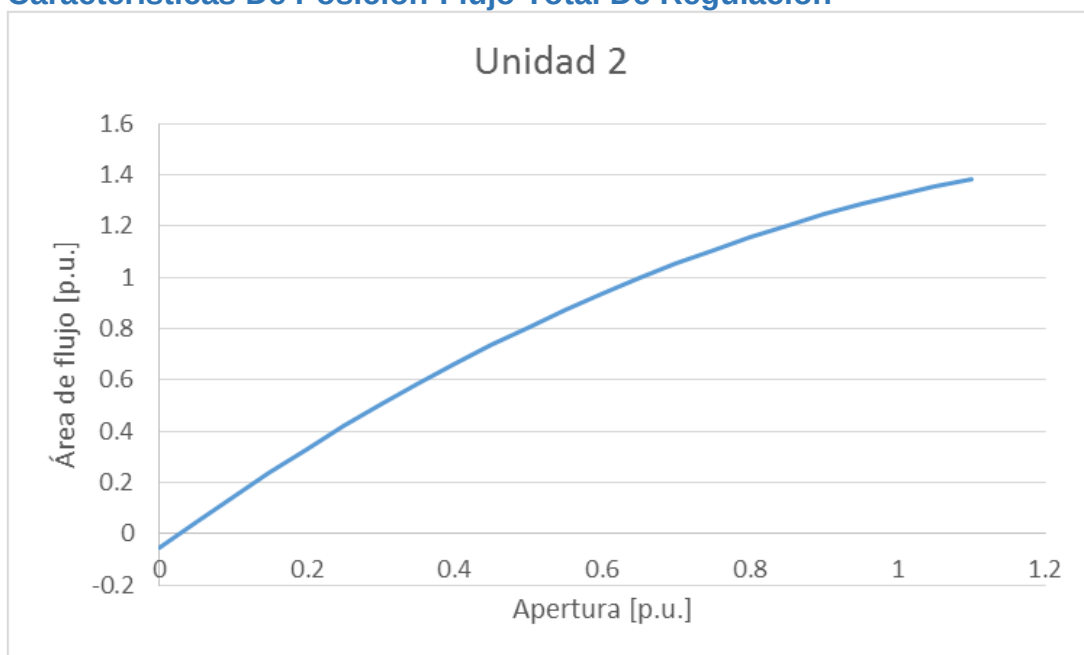


TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >>Turbines_1_4>> GA_2		Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >>Turbines_1_4>> GA_2		Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >>Turbines_1_4>> GA_2	
Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]
0	-0.05604416	0.4	0.6623324	0.85	1.203248
0.05	0.04598039	0.45	0.7364084	0.9	1.245882
0.1	0.1445114	0.5	0.8069909	0.95	1.285022
0.15	0.2395488	0.55	0.8740798	1	1.320669
0.2	0.3310927	0.6	0.9376751	1.05	1.352822
0.25	0.4191429	0.65	0.9977768	1.1	1.381482
0.3	0.5036997	0.7	1.054385		
0.35	0.5847628	0.75	1.1075		
		0.8	1.157121		

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_1_4	
Parámetro	Valor
H_st	1
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_1_4	
Parámetro	Valor
r_p	0.00175
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_1	Ver Tabla 8

ANEXO 5

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 3 DE SAN CARLOS

Sistema de Excitación:

TABLA 2. PARÁMETROS EXCITACIÓN

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U3			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexplT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.8333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexplF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAMin	-6.03	[pu]
AVR output negative ceiling value	VAMinPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAMax	6.85	[pu]
AVR output positive ceiling value	VAMaxPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IFmáx, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U3_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.048
P	0.7
PR_Path_Gain	2
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U3_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.5
Td_DFSP	0.5
Tn_DFSP	5
ADPens	1
TDPens	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U3_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nl	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U3_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	2
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL—POSICIÓN ACTUADOR

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U3_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U3_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U3_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador Network Model >> Network Data >> Grid >> Hydraulics_3	
Parámetro	Valor
T_pilot	0.6
T_main	1.2
T_del	1
pilot_min	-0.2
main_min	0
pilot_max	0.2
main_max	1.15

Características De Posición-Flujo Total De Regulación

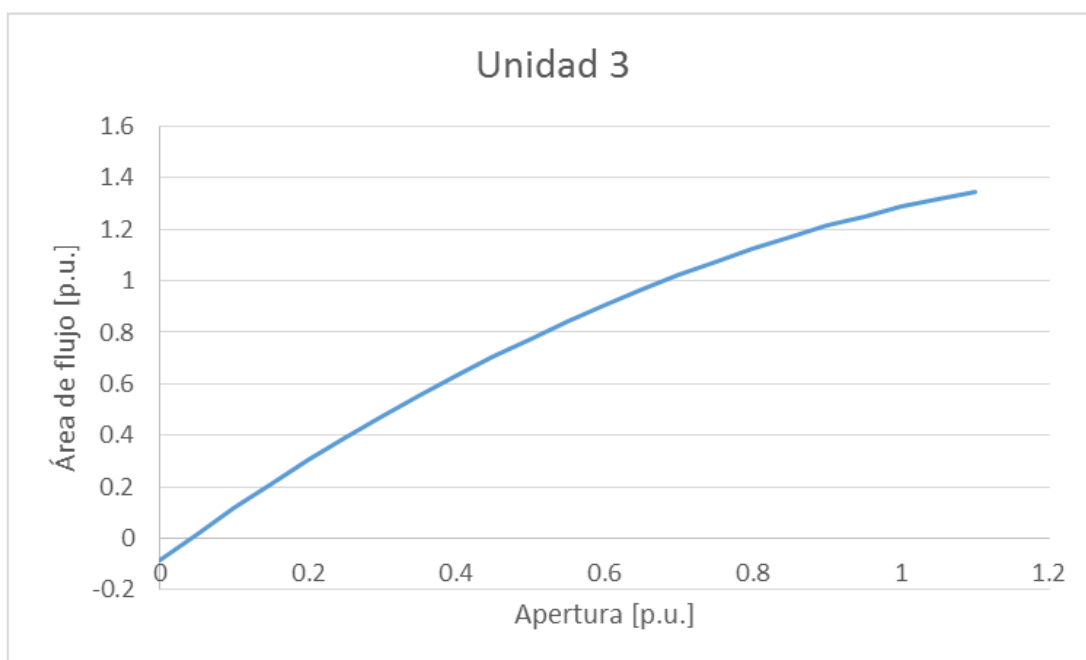


TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_3	
Apertura [p.u.]	Área de flujo [p.u.]
0	-0.08350213
0.05	0.01826315
0.1	0.1165324
0.15	0.2113055
0.2	0.3025826
0.25	0.3903637
0.3	0.4746487
0.35	0.5554376

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_3	
Apertura [p.u.]	Área de flujo [p.u.]
0.4	0.6327304
0.45	0.7065272
0.5	0.776828
0.55	0.8436326
0.6	0.9069413
0.65	0.9667538
0.7	1.02307
0.75	1.075891
0.8	1.125215

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_3	
Apertura [p.u.]	Área de flujo [p.u.]
0.85	1.171043
0.9	1.213376
0.95	1.252212
1	1.287552
1.05	1.319396
1.1	1.347744

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_1_4	
Parámetro	Valor
H_st	1
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_1_4	
Parámetro	Valor
r_p	0.00175
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_1	Ver Tabla 8

ANEXO 6

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 4 DE SAN CARLOS

Sistema de Excitación:

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U4			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexplT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.8333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexplF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAmin	-6.03	[pu]
AVR output negative ceiling value	VAminPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAmaz	6.85	[pu]
AVR output positive ceiling value	VAmazPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IF_{máx}, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U4_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.048
P	0.4
PR_Path_Gain	3.2
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U4_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nl	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U4_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.5
Td_DFSP	0.5
Tn_DFSP	5
ADPens	1
TDPens	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U4_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	3
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL– POSICIÓN ACTUADOR

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U4_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U4_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U4_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador Network Model >> Network Data >> Grid >> Hydraulics_4	
Parámetro	Valor
T_pilot	2
T_main	1.2
T_del	0
pilot_min	-0.04
main_min	0
pilot_max	0.03
main_max	1.13

Características De Posición-Flujo Total De Regulación

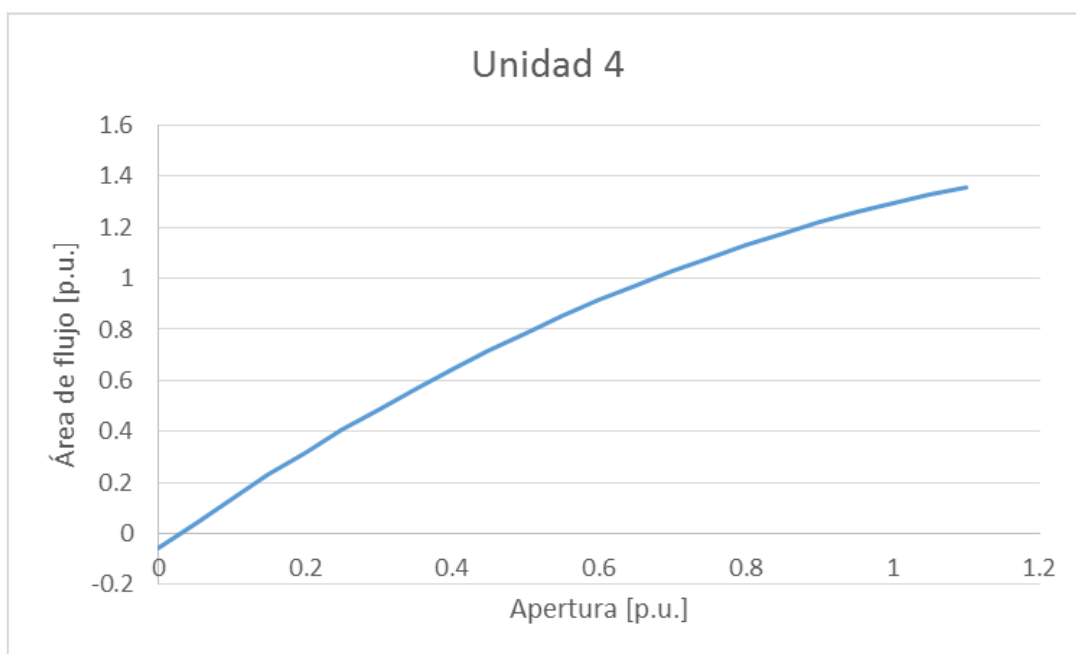


TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador		Características de posición – área de flujo del actuador		Características de posición – área de flujo del actuador	
Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_4		Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_4		Network Model >> Network Data >> Grid >> Turbines_1_4 >> GA_4	
Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]
0	-0.05966292	0.4	0.6433147	0.85	1.176916
0.05	0.03997883	0.45	0.7160547	0.9	1.219391
0.1	0.1362578	0.5	0.7854319	0.95	1.258504
0.15	0.2291741	0.55	0.8514463	1	1.294254
0.2	0.3187277	0.6	0.9140981	1.05	1.326641
0.25	0.4049186	0.65	0.9733871	1.1	1.355666
0.3	0.4877467	0.7	1.029313		
0.35	0.5672121	0.75	1.081877		
		0.8	1.131078		

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_1_4	
Parámetro	Valor
H_st	1
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_1_4	
Parámetro	Valor
r_p	0.00175
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_1	Ver Tabla 8

ANEXO 7

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 5 DE SAN CARLOS

Sistema de Excitación:

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U5			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexplT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.83333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexplF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAmin	-6.03	[pu]
AVR output negative ceiling value	VAminPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAmaz	6.85	[pu]
AVR output positive ceiling value	VAmazPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IFmáx, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U5_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.048
P	0.4
PR_Path_Gain	1.3
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U5_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.5
Td_DFSP	0.5
Tn_DFSP	0.1
ADPens	1
TDPens	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U5_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nI	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U5_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	2
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL— POSICIÓN ACTUADOR

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U5_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U5_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control— posición actuador Network Model >> Network Data >> Grid >> SC_U5_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador Network Model >> Network Data >> Grid >> Hydraulics_5	
Parámetro	Valor
T_pilot	0.6
T_main	0.8
T_del	1
pilot_min	-0.2
main_min	0
pilot_max	0.2
main_max	1.02

Características De Posición-Flujo Total De Regulación

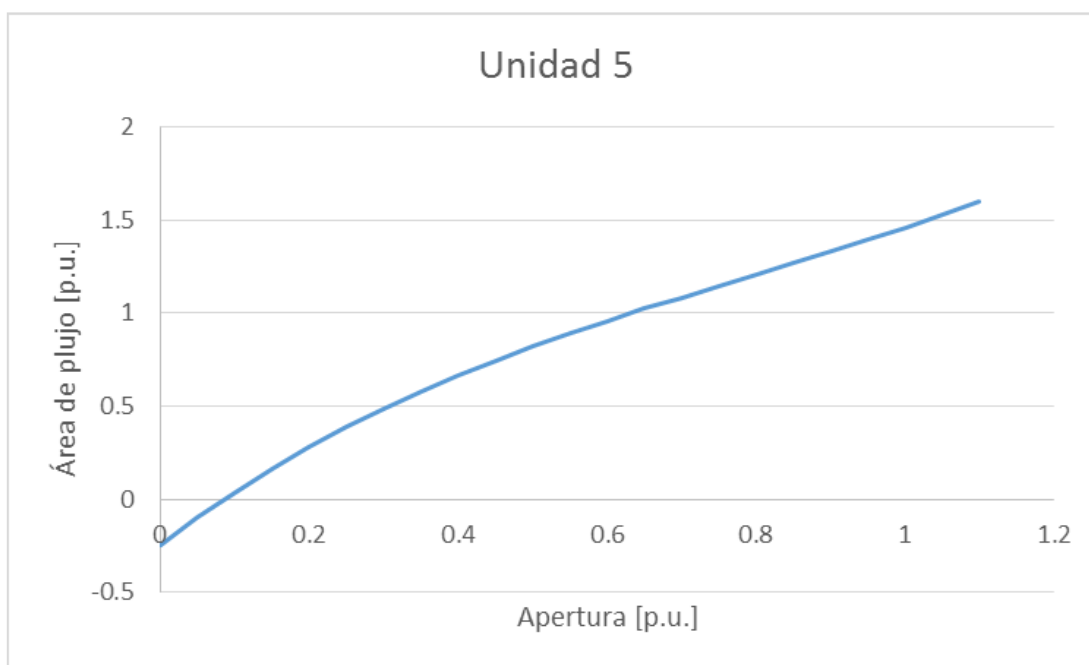


TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador		Características de posición – área de flujo del actuador		Características de posición – área de flujo del actuador	
Network Model >> Network Data >> Grid >> Turbines_5_8>> GA_1		Network Model >> Network Data >> Grid >> Turbines_5_8>> GA_1		Network Model >> Network Data >> Grid >> Turbines_5_8>> GA_1	
Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]	Apertura [p.u.]	Área de flujo [p.u.]
0	-0.2443189	0.4	0.6654963	0.85	1.267072
0.05	-0.0972717	0.45	0.7453922	0.9	1.328858
0.1	0.03875385	0.5	0.8202728	0.95	1.392385
0.15	0.1645085	0.55	0.8908887	1	1.458405
0.2	0.2807431	0.6	0.9579909	1.05	1.527668
0.25	0.3882084	0.65	1.02233	1.1	1.600925
0.3	0.4876552	0.7	1.084657		
0.35	0.5798342	0.75	1.145722		
		0.8	1.206277		

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
H_st	1
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
r_p	0.0025
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_1	Ver Tabla 8

ANEXO 8

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 6 DE SAN CARLOS

Sistema de Excitación:

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U6			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexplT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.8333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexplF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAmin	-6.03	[pu]
AVR output negative ceiling value	VAminPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAmaz	6.85	[pu]
AVR output positive ceiling value	VAmazPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IFmáx, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U6_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.048
P	0.4
PR_Path_Gain	1.8
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U6_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nl	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U6_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.5
Td_DFSP	0.5
Tn_DFSP	0.1
ADPen	1
TDPen	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA Network Model >> Network Data >> Grid >>SC_U6_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	2
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL– POSICIÓN ACTUADOR

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U6_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U6_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U6_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador	
Network Model >> Network Data >> Grid >> Hydraulics_6	
Parámetro	Valor
T_pilot	0.4
T_main	0.8
T_del	1
pilot_min	-0.2
main_min	0
pilot_max	0.2
main_max	1.05

Características De Posición-Flujo Total De Regulación

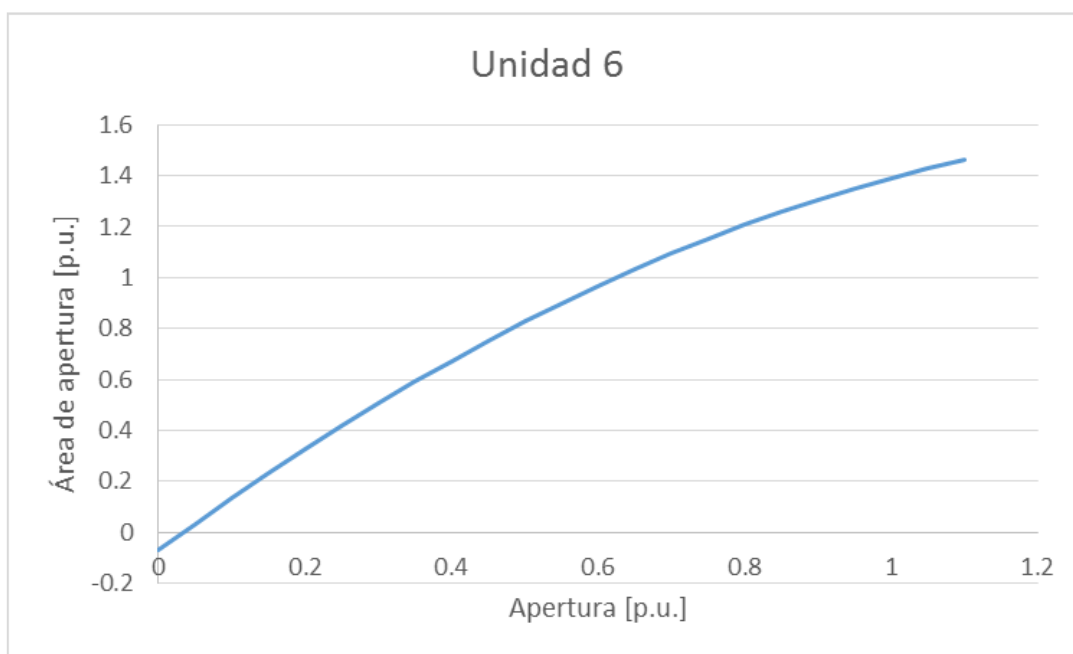


TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_5_8 >> GA_2	
Apertura [p.u.]	Área de flujo [p.u.]
0	-0.073015
0.05	0.03200761
0.1	0.133682
0.15	0.2320083
0.2	0.3269863
0.25	0.4186161
0.3	0.5068978
0.35	0.5918312

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_5_8 >> GA_2	
Apertura [p.u.]	Área de flujo [p.u.]
0.4	0.6734165
0.45	0.7516535
0.5	0.8265424
0.55	0.8980831
0.6	0.9662756
0.65	1.03112
0.7	1.092616
0.75	1.150764
0.8	1.205564

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_5_8 >> GA_2	
Apertura [p.u.]	Área de flujo [p.u.]
0.85	1.257015
0.9	1.305118
0.95	1.349874
1	1.39128
1.05	1.429339
1.1	1.46405

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
H_st	0.99
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
r_p	0.0025
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_2	Ver Tabla 8

ANEXO 9

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 7 DE SAN CARLOS

Sistema de Excitación:

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U6			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexplT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.8333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexplIF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAMin	-6.03	[pu]
AVR output negative ceiling value	VAMinPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAMax	6.85	[pu]
AVR output positive ceiling value	VAMaxPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IFmáx, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U7_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.048
P	0.4
PR_Path_Gain	1.6
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U7_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.5
Td_DFSP	0.5
Tn_DFSP	5
ADPens	1
TDPens	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U7_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nI	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U7_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	2
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL– POSICIÓN ACTUADOR

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U7_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U7_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U7_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador Network Model >> Network Data >> Grid >> Hydraulics_7	
Parámetro	Valor
T_pilot	0.4
T_main	0.8
T_del	1
pilot_min	-0.2
main_min	0
pilot_max	0.2
main_max	1.07

Características De Posición-Flujo Total De Regulación

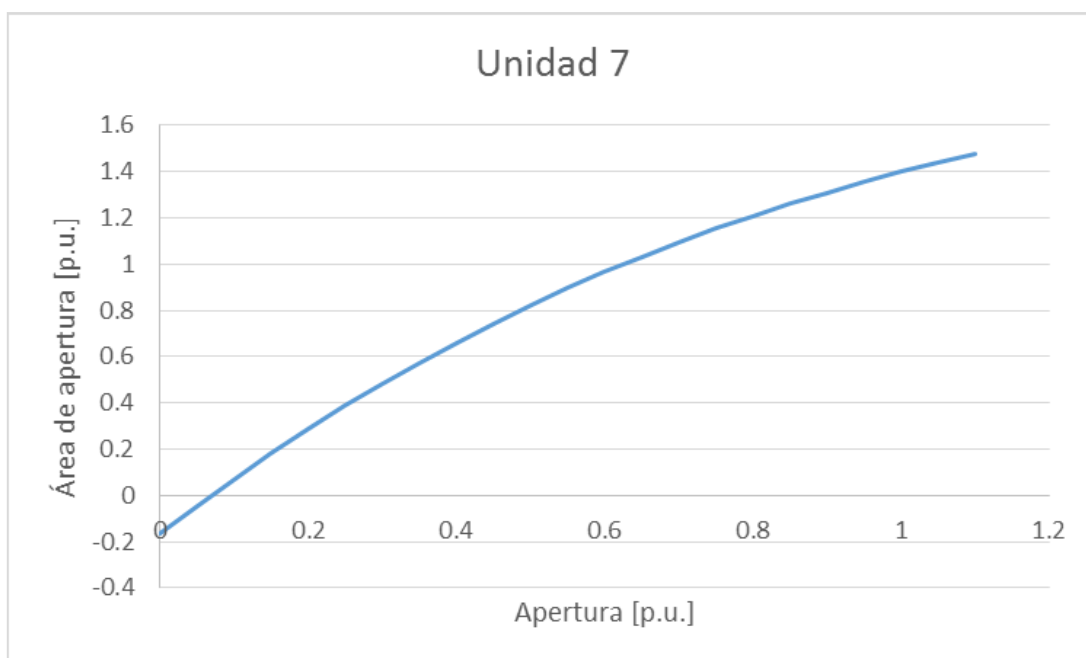


TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_5_8 >> GA_3	
Apertura [p.u.]	Área de flujo [p.u.]
0	-0.1655
0.05	-0.04500945
0.1	0.07029557
0.15	0.1805365
0.2	0.2858346
0.25	0.3863114
0.3	0.4820882
0.35	0.5732864

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_5_8 >> GA_3	
Apertura [p.u.]	Área de flujo [p.u.]
0.4	0.6600275
0.45	0.7424327
0.5	0.8206234
0.55	0.8947211
0.6	0.9648472
0.65	1.031123
0.7	1.09367
0.75	1.152609
0.8	1.208063

Características de posición – área de flujo del actuador Network Model >> Network Data >> Grid >> Turbines_5_8 >> GA_3	
Apertura [p.u.]	Área de flujo [p.u.]
0.85	1.260151
0.9	1.308996
0.95	1.354719
1	1.397442
1.05	1.437286
1.1	1.474371

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
H_st	0.99
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
r_p	0.0025
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_3	Ver Tabla 8

ANEXO 10

TABLAS DE VALORES DE LOS PARÁMETROS DE CONTROL DE LA UNIDAD 8 DE SAN CARLOS

Sistema de Excitación:

Parámetros Excitación			
Network Model >> Network Data >> Grid >> ABB_U8			
Descripción	Parámetro	Valor	Unidad
Converter and gate control unit time constant	Ts	0.004	[s]
Power base reference	Pbase	170	[MW]
Steady State Gain of AVR control loop	KR1	600	[pu/pu]
Active power compensation factor	KIA	0	[pu/pu]
Reactive power compensation factor	KIR	0	[pu/pu]
Controller first lead time constant (SCL cap)	TC14	1.52	[s]
Controller first lag time constant (SCL cap)	TB14	12.67	[s]
Controller second lead time constant (SCL cap)	TC24	0.1	[s]
Controller second lag time constant (SCL cap)	TB24	0.012	[s]
Controller first lead time constant (P/Q)	TC16	3.2	[s]
Controller first lag time constant (P/Q)	TB16	24	[s]
Controller second lead time constant (P/Q)	TC26	0.1	[s]
Controller second lag time constant (P/Q)	TB26	0.1	[s]
Controller first lead time constant (AVR)	TC11	3.2	[s]
Controller first lag time constant (AVR)	TB11	24	[s]
Controller second lead time constant (AVR)	TC21	0.1	[s]
Controller second lag time constant (AVR)	TB21	0.1	[s]

Descripción	Parámetro	Valor	Unidad
Controller first lead time constant (SCL ind)	TC12	3.2	[s]
Controller first lag time constant (SCL ind)	TB12	24	[s]
Controller second lead time constant (SCL ind)	TC22	0.1	[s]
Controller second lag time constant (SCL ind)	TB22	0.1	[s]
Controller first lead time constant (IF max)	TC13	1.5	[s]
Controller first lag time constant (IF max)	TB13	11.25	[s]
Controller second lead time constant (IF max)	TC23	0.1	[s]
Controller second lag time constant (IF max)	TB23	0.1	[s]
Measuring filter time constant	TR	0.01	[s]
release stator current limiter (overexcited)	Release_IGindLim	1	[-]
release stator current limiter (underexcited)	Release_IGcapLim	1	[-]
Gain reduction factor (SCL ind)	KR2i	0.5	[-]
Gain reduction factor (SCL cap)	KR4i	0.5	[-]
Expoent factor of inverse time characteristic (SCL ind)	KexplT	1	[-]
Maximum thermal stator current limit (SCL ind)	ITth	1.05	[pu]
Fixed time integration constant (SCL ind)	Ktol	0.1	[1/s]
Cooling integration constant (SCL ind)	KCI	0.01	[1/s]
Inverse time characteristic integration constant (SCL ind)	KHI	0	[1/s]
Steady state gain adjustment in resp to KR1 (P/Q)	KR6i	0.5	[-]
release minimum field current limiter	Release_PQlim	1	[-]
Steady state gain (P/Q)	KR6	300	[-]
Direct axis unsat. synchronous reactance (P/Q)	MeasConfig_Xd	1.06	[pu]
Quadrature axis unsat. synchronous reactance (P/Q)	MeasConfig_Xq	0.9	[pu]
Expoent factor of inverse time characteristic (V/Hz)	KexpVH	1	[-]
Inverse time integration constant (V/Hz)	KToVH	0	[1/s]
Cooling integration constant (V/Hz)	KCVH	1000	[1/s]
Fixed time integration constant (V/Hz)	KHVH	0.8333333	[1/s]
Maximum V/Hz gradient (V/Hz)	LimGrad	1.3	[pu/pu]
Maximum generator voltage (V/Hz)	VTfn	1.15	[pu]
release minimum field current limiter (V/Hz)	Release_VHLim	1	[-]
Expoent factor of inverse time characteristic (IF max)	KexplIF	1	[-]
Fixed time integration constant (IF max)	KtoF	0.1	[1/s]
Cooling integration constant (IF max)	KCF	0.00666667	[1/s]
Inverse time characteristic integration constant (IF max)	KHF	0	[1/s]
Gain reduction factor for IFMax limiter (IF max)	KR3i	0.5	[-]
Maximum field current limit (IF max)	Ifmax	1.72	[pu]
release minimum field current limiter	Release_IFmaxLim	1	[-]
Maximum thermal field current limit (IF max)	Ifth	1.697	[pu]
	KH_	26.535	

Descripción	Parámetro	Valor	Unidad
	KG_	0	
	KB1_	10.217	
	KB2_	10.217	
	KI1_	10.217	
	KI2_	10.217	
	KH1_	10.217	
	KH2_	10.217	
	KB_	2.417	
	KI_	4.835	
	T7_	6.4	
	KB11_	1	
	TB1_	5.813153	
	TB2_	3.890786	
	KB17_	1	
	TB7_	3.890786	
	TB8_	2.604132	
	KI11_	1	
	TI1_	0.64355	
	TI2_	0.430732	
	KI17_	1	
	TI7_	0.430732	
	TI8_	0.288292	
	KH11_	1	
	TH1_	0.058024	
	TH2_	0.038836	
	KH17_	1	
	TH7_	0.038836	
	TH8_	0.025993	
	TB3_	9.24601	
	TB4_	4.541697	
	TB5_	9.2659	
	TB6_	4.544952	
	TB9_	9.24601	
	TB10_	4.541697	
	TB11_	9.2659	
	TB12_	4.544952	
	TI3_	0.232115	
	TI4_	0.113542	
	TI5_	0.231649	

Descripción	Parámetro	Valor	Unidad
	TI6_	0.113624	
	TI9_	0.23115	
	TI10_	0.113542	
	TI11_	0.231648	
	TI12_	0.113624	
	TH3_	0.070756	
	TH4_	0.034756	
	TH5_	0.070531	
	TH6_	0.034596	
	TH9_	0.070756	
	TH10_	0.034756	
	TH11_	0.070531	
	TH12_	0.034596	
Maximum terminal voltage level for PSS blocking	VTmax	1.1	[pu]
Terminal voltage limit value for reduction of PSS maximum limit of PSS signal	VTSLmax	1.07	[pu]
Minimum terminal voltage level for PSS blocking	VTmin	0.9	[pu]
Minimum active power level for PSS release	PTmin	0.3	[pu]
PSS release parameter	PSSEnable	1	[-]
PSS block parameter	BlockPSS	0	[-]
PSS release time delay	TON	0	[s]
Integration time of VTSLmax limitation	TSL	1	[s]
AVR output negative ceiling value	VAMin	-6.03	[pu]
AVR output negative ceiling value	VAMinPSS	-3	[pu]
	VBmin_	-0.075	[pu]
	VImin_	-0.6	[pu]
	VHmin_	-0.1	[pu]
AVR output positive ceiling value	VAMax	6.85	[pu]
AVR output positive ceiling value	VAMaxPSS	3	[pu]
	VBmax_	0.075	[pu]
	VImax_	0.6	[pu]
	VHmax_	0.1	[pu]
Minimum limit for PSS signal	VSmax	0.05	[pu]
PQ	x0	0	
	x1	0.2	
	x2	0.4	
	x3	0.6	
	x4	0.8	
	x5	1	
Descripción	Parámetro	Valor	Unidad
	y0	-0.69	
	y1	-0.68	
	y2	-0.64	
	y3	-0.58	
	y4	-0.46	
	y5	-0.18	

Regulador de tensión (AVR)

Limitador de sobreexcitación, IFmáx, OEL

Limitador de Subexcitación, P/Q, UEL

Limitador de máxima corriente estatórica, SCL

Limitador V/HZ

Estabilizador del Sistema de Potencia

Regulador de Velocidad/Potencia y Turbina

Almenara

TABLA 4. PARÁMETROS DE LA ALMENADA.

	Surge Tank 1	
	Sección 1	Sección 2
Gross Min [m]	702	531.875
Gross Max [m]	807	702
Net Min [m]	519.65	349.53
Net Max [m]	624.65	519.65
Net Min [pu]	0.94	0.63
Net Max [pu]	1.13	0.94
Diametro [m]	13.50	5.30
Ts [s]	1855.50	463.37

Conducción y turbina hidráulica

Modelo del Regulador de Velocidad

TABLA 5. PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U8_Gov_Contr	
Parámetro	Valor
Freq_db	0.0005
bp_SPC	0.048
P	0.4
PR_Path_Gain	0.9
I	0.1111
Lead_B	1
Lead_A	5.625

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U8_Gov_Contr	
Parámetro	Valor
Tcontroller	1
Tn_pa	0.5
Td_DFSP	0.5
Tn_DFSP	5
ADPens	1
TDPens	0.5
T_rate_lim	0.01

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U8_Gov_Contr	
Parámetro	Valor
Lead_D	1
Lead_C	1.266
Lag_B	1
Lag_A	7.844
Lag_D	1
Lag_C	17.26
q_nl	0.17
Tcontroller_2	3
TN_Hdyn	1

PARÁMETROS DEL CONTROL DE VELOCIDAD - POTENCIA	
Network Model >> Network Data >> Grid >>SC_U8_Gov_Contr	
Parámetro	Valor
A_rate_lim	0.00001
C	0.688
Ctrl_Min	0
Ctrl_Max	2
Qst_Yst	Tabla 6

TABLA 6. CARACTERÍSTICAS DE CONTROL– POSICIÓN ACTUADOR

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U8_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0	0
0.05	0.05
0.1	0.1
0.15	0.15
0.2	0.2
0.25	0.25
0.3	0.3
0.35	0.35
0.4	0.4
0.45	0.45

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U8_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
0.5	0.5
0.55	0.55
0.6	0.6
0.65	0.65
0.7	0.7
0.75	0.75
0.8	0.8
0.85	0.85
0.9	0.9
0.95	0.95
1	1
1.05	1.05
1.1	1.1

Características de Control– posición actuador Network Model >> Network Data >> Grid >> SC_U8_Gov_Contr >> Qst_Yst	
Apertura [p.u.]	Área de flujo [p.u.]
1.15	1.15
1.2	1.2
1.25	1.25
1.3	1.3
1.35	1.35
1.4	1.4
1.45	1.45
1.5	1.5
1.55	1.55
1.6	1.6

Modelo dControl de Válvulas

TABLA 7. PARÁMETROS DE CONTROL DE ACTUADOR

Parámetros de control de actuador Network Model >> Network Data >> Grid >> Hydraulics_8	
Parámetro	Valor
T_pilot	0.4
T_main	0.8
T_del	1
pilot_min	-0.2
main_min	0
pilot_max	0.1
main_max	1.065

Características De Posición-Flujo Total De Regulación

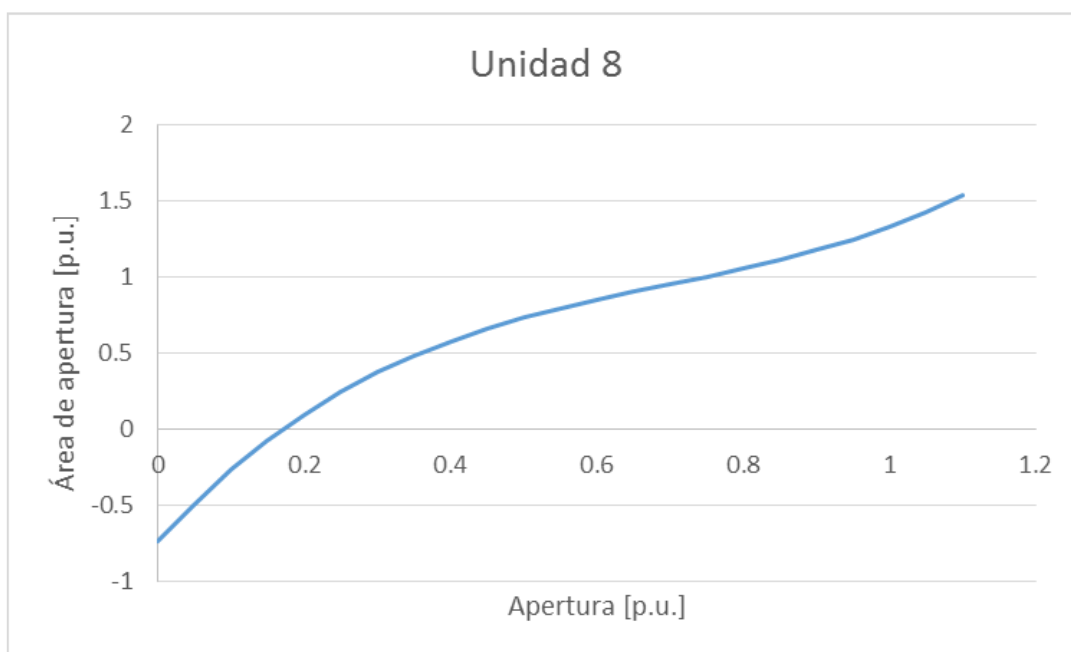


TABLA 8. CARACTERÍSTICAS DE POSICIÓN – ÁREA DE FLUJO DEL ACTUADOR

Características de posición – área de flujo del actuador	
Network Model >> Network Data >> Grid >> Turbines_5_8>> GA_4	
Apertura [p.u.]	Área de flujo [p.u.]
0	-0.7351725
0.05	-0.486015
0.1	-0.2654953
0.15	-0.07139869
0.2	0.09848943
0.25	0.2463837
0.3	0.3744988
0.35	0.4850493

Características de posición – área de flujo del actuador	
Network Model >> Network Data >> Grid >> Turbines_5_8>> GA_4	
Apertura [p.u.]	Área de flujo [p.u.]
0.4	0.5802499
0.45	0.6623151
0.5	0.7334598
0.55	0.7958984
0.6	0.8518457
0.65	0.9035163
0.7	0.9531247
0.75	1.002886
0.8	1.055014

Características de posición – área de flujo del actuador	
Network Model >> Network Data >> Grid >> Turbines_5_8>> GA_4	
Apertura [p.u.]	Área de flujo [p.u.]
0.85	1.111724
0.9	1.175231
0.95	1.247748
1	1.331492
1.05	1.428675
1.1	1.541514

Modelo turbina y último segmento de conducción

Modelo conjunto de turbinas y conducción

TABLA 9. PARÁMETROS DE CONDUCCIÓN Y TURBINA

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
H_st	0.99
Tw3	0.2
T_w_t	1
T_w_p	0.3
Tw4	0.2
Tw1	0.2
Tw2	0.2
T_el2	20
T_el3	20
T_el4	20
T_el1	20
r_p3	0.01
r_p1	0.01
r_t	0.0025

Parámetros de conducción y turbina	
Network Model >> Network Data >> Grid >> Turbines_5_8	
Parámetro	Valor
r_p	0.0025
T_el_p	666.6667
r_p4	0.01
r_p2	0.01
T_s	1885
Turb_Gain	0.9054
Pbase	168
GA_4	Ver Tabla 8