Supporting information for:

Regulatory Control of Amine Scrubbing for CO_2 Capture from Power Plants

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Power Plant Model Parameters

Table S1: Power plant operating conditions

	Value
P_{boiler}	24.1 MPa
T_{boiler}	593°C
Q_{boiler} (full-load)	1410 MW
Q_{RH} (full-load)	357 MW
$\hat{H}_{feedwater}$	1250 kJ/kg
$P_{condenser}$	6.89 kPa
C_v (extraction valve)	0.248 m^2

Table S2: Flow constants ($Pa^2 \cdot s^2/K \cdot kg^2$) for uncontrolled extractions to the next turbine stage (ϕ_{Di}) and to the feedwater heater (ϕ_{Dxi})

Turbine	Stage (i)	ϕ_{Di}	ϕ_{Dxi}
HP	1	1.71 X 10^6	4.86 X 10^8
	2	1.98 X 10^5	8.03 X 10^6
IP	3	1.06 X 10^5	1.89 X 10^7
	4	3.82 X 10^5	2.66 X 10^7
LP	5	8.52 X 10^3	4.24 X 10^6
	6	1.55 X 10^3	9.68 X 10^5
	7	295	3.93 X 10^5
	8	44.8	9.51 X 10^4
	9	13.4	–

Controller Parameters

The discrete-time PI control law is given in Equation S.1. A one second sampling time (t_s) was assumed. The parameters for the controllers used in this work are listed in Table S3.

$$u = \overline{u} + K_P(x_{SP} - x_k) + K_I t_s \sum_{k=-\infty}^{n} (x_{SP} - x_k) \tag{S.1}$$

Table S3: P and PI controller parameters

u	$\overline{u}$	x	x_{SP}	K_P	K_I
F_{FT}	99.3 kmol/s	l_{FT}	9.8 m	-540 kmol/m·s	–
F_{IC}	102 kmol/s	l_{CT}	1.0 m	-1950 kmol/m·s	–
F_{SU}	103 kmol/s	l_{SU}	2.6 m	-1950 kmol/m·s	–
F_{WW1}	32.1 kmol/s	l_{WT}	1.0 m	-590 kmol/m·s	–
F_{WW2}	30.9 kmol/s	T^V_{WW}	315.2 K	65 kmol/K·s	0.477 kmol/K·s^2
q_v	1	T_{SH}	426.0 K	0.0500 1/K	0.0220 1/K·s
F_{CO2}	2.50 kmol/s	T_{SH}	426.0 K	-2.00 kmol/K·s	-0.0733 kmol/K·s^2
		Rem	90%	0.0160 kmol/s	4.88 X 10^{-5} kmol/s^2
		P_{ST}	6.01 bar	-0.0120 kmol/bar·s	-5.30 X 10^{-3} kmol/bar·s^2

Notation

Greek

ϕ_{Di}	flow constant for uncontrolled steam extraction to next stage
ϕ_{Dxi}	flow constant for uncontrolled steam extraction to feedwater heater

Roman

C_v	steam extraction valve flow coefficient
F_{CO2}	CO_2 flowrate through multi-stage compressor
F_{FT}	flash tank effluent flowrate
F_{IC}	absorber chimney tray effluent flowrate
F_{SU}	absorber sump effluent flowrate
F_{WW1}	water tank effluent flowrate
F_{WW2}	water wash chimney tray effluent flowrate
$\hat{H}_{feedwater}$	specific enthalpy of boiler feedwater
K_I	integral gain
K_P	proportional gain
l_{CT}	absorber chimney tray level
l_{FT}	flash tank level
l_{SU}	absorber sump level
l_{WT}	water tank level
P_{boiler}	supercritical boiler pressure

$P_{condenser}$	LP steam condenser
P_{ST}	stripper pressure
Q_{boiler}	duty applied to boiler feedwater
Q_{RH}	reheating duty applied to steam exiting HP turbine
q_V	steam extraction valve stem position
Rem	CO_2 removal rate from the flue gas
T_{boiler}	supercritical boiler temperature
t_s	sampling time
T_{SH}	steam heater outlet temperature
T_{WW}^V	water wash outlet vapor temperature
u	manipulated variable
$\overline{u}$	nominal value for manipulated variable
x	controlled variable
x_{SP}	set point for controlled variable