

SCR Cost and Cost-Effectiveness Worksheet				
Variable	Designation	Units	Calculation	Notes
Plant Name			Brunner Island	
Unit			1	
Unit Size	A	MW	363	
Gross Heat Rate	C	Btu/kWhr	10023	[NEEDS v 5.13]
NOx Rate	D	lb/MMBtu	0.37	[NEEDS v 5.13]
CF	J	CF	0.64	[Assume]
Type of Coal	F		BIT	[NEEDS v 5.13]
Coal Factor	G		1	Bit=1; PRB=1.05; Lig=1.07
Retrofit Factor	B		1	1 = typical retrofit
HR Factor	H		1.0023	C/10000
Heat Input	I	Btu/hr	3.64E+09	A*C*1000
CF	J		0.64	[Assume]
NOx Removal Eff	K	%	80.0%	[Assume]
NOx Removal factor	L		1.00	equals K/80%
NOx Removed	M	lb/hr	1.08E+03	D*I/10^6*K
Urea rate (100%)	N	lb/hr	752	M*0.525*60/46*1.01/99
Steam Required	O	lb/hr	850	N*1.13
Aux. Power	P	%	0.56	0.56*(G*H)^0.43
Urea Cost (50% sol)	R	\$/ton	400	Default
Catalyst Cost	S	\$/m3	8000	Default
Aux Power Cost	T	\$/kwh	0.06	Default
Steam Cost	U	\$/klb	4	Default
Operating Labor Rate	V	\$/hr	60	Default
<b>Capital Cost Calculation</b>				
BMR (\$)	= SCR		40,860,579	
BMF (\$)	= base reagent preparation cost		2,348,729	
BMA (\$)	= APH (SO2> 3lb/MMBtu)			
BMB (\$)	= fans/aux power		4,522,342	
BM (\$)	= Total base cost		47,731,650	
BM (\$/kW)	=		131	
<b>Total Project Cost</b>				
A1 = 10% of BM (\$)	= Eng. and Construction management		4,773,165	
A2 = 10% of BM (\$)	= Labor adjustment		4,773,165	
A3 = 10% of BM (\$)	= Contractor profit/fees		4,773,165	
CECC (\$)	= Cap., Eng. and management		62,051,145	
CECC (\$/kw)	=		171	
B1 = 5% of CECC	= owners cost		-	
B2 = 6% of CECC + B1	= AFUDC (2yr cycle)		-	
TPC (\$)	= Total project cost		62,051,145	
TPC (\$/kw)	=		171	
<b>Fixed O&amp;M Cost</b>				
FOMO (\$/kw-yr)	= fixed O&M - additional labor cost		0.2	
FOMM (\$/kw-yr)	= fixed O&M - additional maintenance, mtl and labor cost		0.8	
FOM (\$/kw-yr)	= Total Fixed O&M Cost		1.00	
<b>Variable O&amp;M Cost</b>				
VOMR (\$/MWhr)	= Variable O&M - urea		0.83	
VOMW (\$/MWhr)	= Variable O&M - catalyst disposal		0.43	
VOMP (\$/MWhr)	= Variable O&M Power		0.34	
VOMM (\$/MWhr)	= Variable O&M - steam		0.009	
VOM (\$/MWhr)	= Total Variable O&M Cost		1.60	
CR			9.44%	[See below]
Property Taxes and Insurance			1.50%	[Assume]
Total Charge Rate			10.94%	
<b>Cost of control - \$/Ton</b>				
CF			64%	
Control Efficiency			80%	
<b>Uncontrolled Rate</b>				
NOx Rate (lb/hr)			1346	
NOx Rate (lb/MMBtu)			0.370	
NOx (TPY)			3774	
<b>Controlled Rate</b>				
NOx Rate (lb/hr)			269.2	
NOx Rate (lb/MMBtu)			0.07	
NOx (TPY)			755	
Tons/Year Removed			3019	
Total Cost/year			\$10,412,348	
\$/Ton			\$3,449	

CRF Calculation			
Annual Interest Rate, i			0.07
# of Years, N			20
Intermediate Calc			0.2709
Intermediate Calc			2.870
CRF			0.0944

SCR Cost and Cost-Effectiveness Worksheet				
Variable	Designation	Units	Calculation	Notes
Plant			Brunner Island	
Unit			2	
Unit Size	A	MW	405	
Gross Heat Rate	C	Btu/kWhr	9695	[NEEDS v 5.13]
NOx Rate	D	lb/MMBtu	0.36	[NEEDS v 5.13]
CF	J	CF	0.68	[Assume]
Type of Coal	F		BIT	[NEEDS v 5.13]
Coal Factor	G		1	Bit=1; PRB=1.05; Uig=1.07
Retrofit Factor	B		1.25	1 = typical retrofit
HR Factor	H		0.9695	C/10000
Heat Input	I	Btu/hr	3.93E+09	A*C*1000
CF	J		0.68	[Assume]
NOx Removal Eff	K	%	80.0%	[Assume]
NOx Removal factor	L		1.00	equals K/80%
NOx Removed	M	lb/hr	1.13E+03	D*I/10*6*K
Urea rate (100%)	N	lb/hr	790	M*0.525*60/46*1.01/.99
Steam Required	O	lb/hr	893	N*1.13
Aux. Power	P	%	0.55	0.56*(G+H)*0.43
Urea Cost (50% sol)	R	\$/ton	400	Default
Catalyst Cost	S	\$/m3	8000	Default
Aux Power Cost	T	\$/kwh	0.06	Default
Steam Cost	U	\$/Klb	4	Default
Operating Labor Rate	V	\$/hr	60	Default
<b>Capital Cost Calculation</b>				
BMR (\$)	SCR		54,785,437	
BMF (\$)	base reagent preparation cost		2,377,567	
BMA (\$)	APH (SO2> 3lb/MMBtu)			
BMB (\$)	fans/aux power		5,836,800	
BM (\$)	Total base cost		62,999,803	
BM (\$/KW)			156	
<b>Total Project Cost</b>				
A1 = 10% of BM (\$)	Eng. and Construction management		6,299,980	
A2 = 10% of BM (\$)	Labor adjustment		6,299,980	
A3 = 10% of BM (\$)	Contractor profit/fees		6,299,980	
CECC (\$)	Cap., Eng. and management		81,899,744	
CECC (\$/kw)			202	
B1 = 5% of CECC	owners cost		-	
B2 = 6% of CECC + B1	AFUDC (2yr cycle)		-	
TPC (\$)	Total project cost		81,899,744	
TPC (\$/kw)			202	
<b>Fixed O&amp;M Cost</b>				
FOMO (\$/kw-yr)	fixed O&M - additional labor cost		0.2	
FOMM (\$/kw-yr)	fixed O&M - additional maintenance, mtl and labor cost		0.7	
FOM (\$/kw-yr)	Total Fixed O&M Cost		0.89	
<b>Variable O&amp;M Cost</b>				
VOMR (\$/MWhr)	Variable O&M - urea		0.78	
VOMW (\$/MWhr)	Variable O&M - catalyst disposal		0.40	
VOMP (\$/MWhr)	Variable O&M Power		0.33	
VOMM (\$/MWhr)	Variable O&M - steam		0.009	
VOM (\$/MWhr)	Total Variable O&M Cost		1.52	
CR =			9.44%	[See Unit 1 spreadsheet]
Property Taxes and Insurance			1.50%	[Assume]
Total Charge Rate			10.94%	
<b>Cost of control - \$/Ton</b>				
CF			68%	
Control Efficiency			80%	
<b>Uncontrolled Rate</b>				
NOx Rate (lb/hr)			1414	
NOx Rate (lb/MMBtu)			0.360	
NOx (TPY)			4210	
<b>Controlled Rate</b>				
NOx Rate (lb/hr)			282.7	
NOx Rate (lb/MMBtu)			0.07	
NOx (TPY)			842	
Tons/Year Removed			3368	
Total Cost/year			\$12,997,759	
\$/Ton			\$3,859	

SCR Cost and Cost-Effectiveness Worksheet				
Variable	Designation	Units	Calculation	Notes
Plant			Brunner Island	
Unit			3	
Unit Size	A	MW	790	
Gross Heat Rate	C	Btu/kW/hr	9502	[NEEDS v 5.13]
NOx Rate	D	lb/MMBtu	0.38	[NEEDS v 5.13]
CF	J	CF	0.66	[Assume]
Type of Coal	F		BIT	[NEEDS v 5.13]
Coal Factor	G		1	Bit=1; PRB=1.05; Lig=1.07
Retrofit Factor	B		1	1 = typical retrofit
HR Factor	H		0.9502	C/10000
Heat Input	I	Btu/hr	7.51E+09	A*C*1000
CF	J		0.66	[Assume]
NOx Removal Eff	K	%	80.0%	[Assume]
NOx Removal factor	L		1.00	equals K/80%
NOx Removed	M	lb/hr	2.28E+03	D*/10^6*K
Urea rate (100%)	N	lb/hr	1594	M*0.525^60/46*1.01/.99
Steam Required	O	lb/hr	1801	N*1.13
Aux. Power	P	%	0.55	0.56*(G*H)^0.43
Urea Cost (50% sol)	R	\$/ton	400	Default
Catalyst Cost	S	\$/m3	8000	Default
Aux Power Cost	T	\$/kwh	0.06	Default
Steam Cost	U	\$/Klb	4	Default
Operating Labor Rate	V	\$/hr	60	Default
<b>Capital Cost Calculation</b>				
BMR (\$)	SCR		79,557,157	
BMF (\$)	base reagent preparation cost		2,833,758	
BMA (\$)	APH (SO2> 3lb/MMBtu)			
BMB (\$)	fans/aux power		6,130,124	
BM (\$)	Total base cost		88,521,039	
BM (\$/KW)			112	
<b>Total Project Cost</b>				
A1 = 10% of BM (\$)	Eng. and Construction management		8,852,104	
A2 = 10% of BM (\$)	Labor adjustment		8,852,104	
A3 = 10% of BM (\$)	Contractor profit/fees		8,852,104	
CECC (\$)	Cap., Eng. and management		115,077,351	
CECC (\$/kw)			146	
B1 = 5% of CECC	owners cost		-	
B2 = 6% of CECC + B1	AFUDC (2yr cycle)		-	
TPC (\$)	Total project cost		115,077,351	
TPC (\$/kw)			146	
<b>Fixed O&amp;M Cost</b>				
FOMO (\$/kw-yr)	fixed O&M - additional labor cost		0.1	
FOMM (\$/kw-yr)	fixed O&M - additional maintenance, mtl and labor cost		0.4	
FOM (\$/kw-yr)	Total Fixed O&M Cost		0.46	
<b>Variable O&amp;M Cost</b>				
VOMR (\$/MW/hr)	Variable O&M - urea		0.81	
VOMW (\$/MW/hr)	Variable O&M - catalyst disposal		0.42	
VOMP (\$/MW/hr)	Variable O&M Power		0.33	
VOMM (\$/MW/hr)	Variable O&M - steam		0.009	
VOM (\$/MW/hr)	Total Variable O&M Cost		1.56	
CR			9.44%	[See Unit 1 spreadsheet]
Property Taxes and Insurance			1.50%	[Assume]
Total Charge Rate			10.94%	
<b>Cost of control - \$/Ton</b>				
CF			66%	
Control Efficiency			80%	
<b>Uncontrolled Rate</b>				
NOx Rate (lb/hr)			2853	
NOx Rate (lb/MMBtu)			0.380	
NOx (TPY)			8246	
<b>Controlled Rate</b>				
NOx Rate (lb/hr)			570.5	
NOx Rate (lb/MMBtu)			0.08	
NOx (TPY)			1649	
Tons/Year Removed			6597	
Total Cost/year			\$20,077,761	
\$/Ton			\$3,044	