EMx™ Multi-Pollutant Control Technology

EmeraChem Power™

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August 3, 2009
Pasadena Convention Center

EMx Establishes New Basis For BACT

- All criteria pollutants
  - NOx
  - CO
  - NH3
  - Formaldehyde
  - Benzene
  - VOCs
  - Sulfur
- Operating performance is a matter of public record but has not yet reset the BACT standards

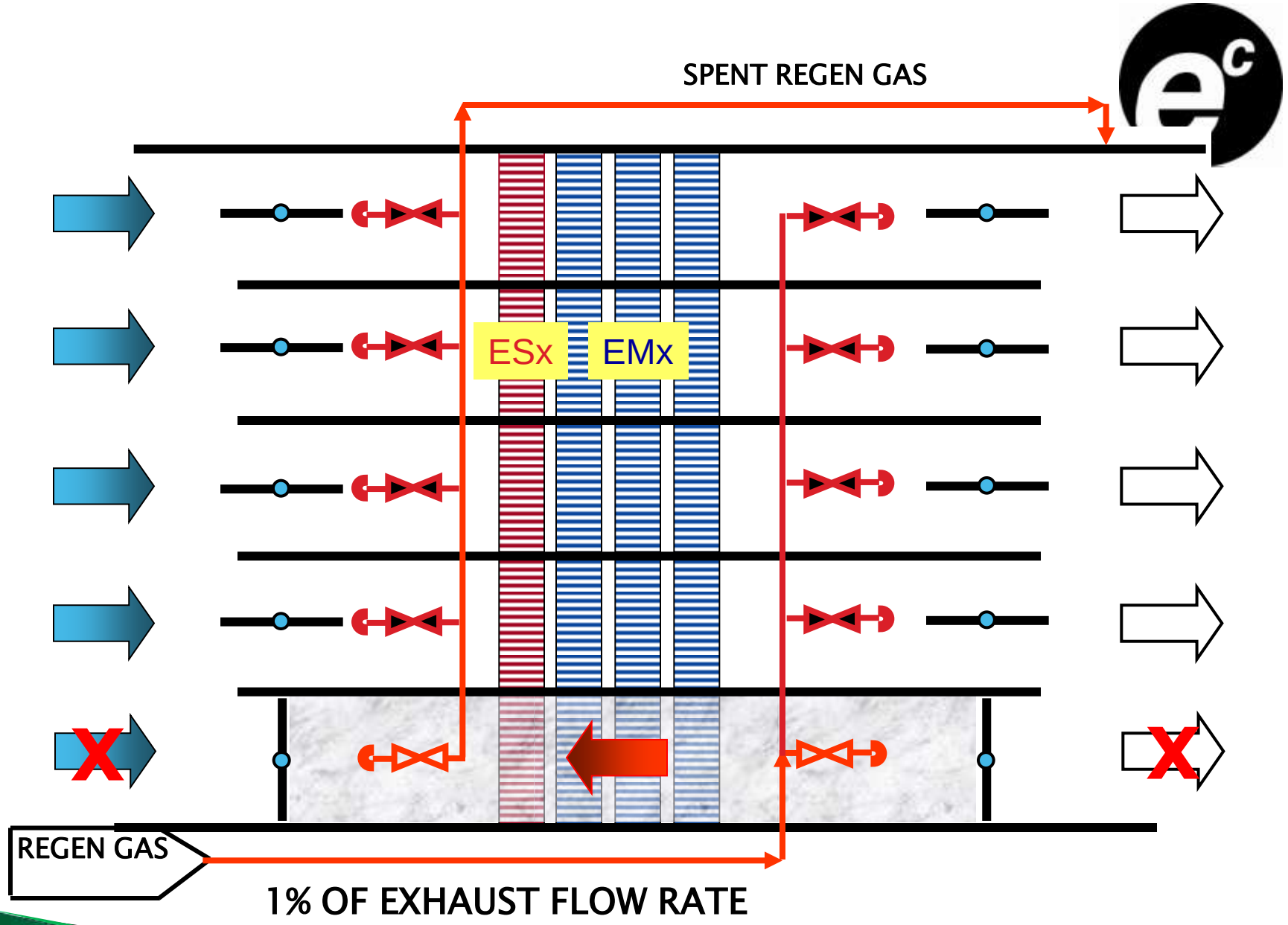
Gas Turbine Application

- Redding Electric Utility, Unit 5
  - 45 MW Alstom GTX-100 gas turbine

Year	Average ppm NOx dry @ 15 % O2
2002	**0.93**
2003	**1.06**
2004	**1.04**
2005	**0.67**
2006	**0.54**
2007	**0.76**
2008	**0.62**

In every year of operation Redding Unit 5 has been the cleanest GT EGF in the State of California‡

‡source: U.S. EPA


SPENT REGEN GAS
ESx
EMx
REGEN GAS
1% OF EXHAUST FLOW RATE

Comparison of EmeraChem Power SCR and EMx

	SCR	EMx™
Additional catalyst system required for CO and VOC reduction?	yes; SCR reduces NOx only	no; EMx™ is a multi-pollutant catalyst
NOx emission @15-25 ppm NOx inlet	1.5 – 2.5 ppm	0.4 – 1.5 ppm
NH3 slip @15-25 ppm NOx inlet	5 – 10 ppm	0
NOx emission @ <10 ppm NOx inlet	2 – 5 ppm	0.2 – 1.0 ppm
NH3 slip @ <10 ppm NOx inlet	2 – 10 ppm	0
Additional catalyst required when NOx inlet <10 ppm?	yes	No
Fine Particulate (PM-10)	SCR generates PM-10	EMx™ reduces PM-10
Disposition of spent catalyst	hazardous; solid waste	non-hazardous; recovery value for platinum precious metal

EMx Performance & Operational Status

Installation	On-Line Date	GT Power, MW	Operational Hours	Operating Temp (F)	Reduction % Guaranteed/ Expected	Average NOx Out (ppm)
Wyeth Biopharma Unit 2 Solar Taurus 60	9/1/03	5.5	37,167	625	90/>95	<0.5 gas <2.0 oil
Montefiore Medical Center Solar Taurus 60	6/1/02	5.5	47,684	525	90/>95	<0.7
Redding Electric Unit 5 Alstom GTX 100	6/1/02	45	41,084	525	95/>95	<0.5
UCSD Cogen Facility 2x Solar Titan 130	7/1/01	2x15	110,788	420	90/>95	<1.0
Wyeth Biopharma Unit 1 Solar Taurus 60	1/1/99	5.5	76,382	650	90/>95	<1.5 gas <10.0 oil
Sunlaw Federal GE LM2500	1996 (decom)	32	25,000	310	95/>95	<1.0
Sunlaw Growers GE LM2500	1996 (decom)	32	16,000	310	95/>95	<1.0
Total Installed Capacity		156 MW	370,106			

Net Emission Reduction of Criteria Pollutants EMx vs. SCR for a 7FA Combined Cycle

	Removal Efficiencies		Annual Emissions Controlled (TPY)		Annual Guaranteed Emissions Reduction with EMx (TPY)	10 Year Guaranteed Emissions Reduction with EMx (tons)
	EMx	SCR	EMx	SCR		
NOx	94%	90%	187	178	8.9	89.2
CO	99%	90%	119	108	11.1	110.7
VOC	90%	50%	8.6	5.3	3.3	33
SO_2	97%	0	4.5	0.0	4.5	45
NH3	n/a	slip	39.1	0.0	39.1	391
PM-10	30%	0	82.6	0.0	82.6	826
Emission Reduction with EM x					149.5	1495

Cost Effectiveness

- Capital Recovery Analysis
  - 10 % interest rate
  - 15 year annuity
  - Fixed current dollars

	Cost Effectiveness			
	LM6000		GE 7FA	
	SCR	EMx	SCR	EMx
Total Capital Investment	$ 4,104,730	$ 7,256,357	$ 12,687,346	$ 15,651,488
Annual Operating Cost	$ 1,663,190	$ 2,094,840	$ 4,961,113	$ 5,260,678
Levelized Cost of Control, $/ton-NOx	20,952	22,694	27,854	27,996

Total Capital Investment costs include the system equipment, catalyst, engineering and installation, commissioning and start-up and shipping charges

Implications – Advanced Technology Enables Advanced Clean Air Policy

- Ultra-clean technology supports CAA attainment objectives
- BACT analysis for discrete pollutants can give way to a *combined BACT* analysis for multi-pollutants
  - Regulatory advantages
  - Business/economic advantages
- Consider ultra fast-track permitting for power plant applications with advanced technology for ultra-low emissions

Implications – Advanced Technology Enables Advanced Clean Air Policy

- "Optimal plant" is a combined cycle configuration with ultra-clean EMx technology
  - Supports objectives of AB32 by reducing CO2 by 33% per MW generated
  - Supports reductions of all criteria pollutants
- Enables new capacity to be permitted therefore satisfying California's growing power demands