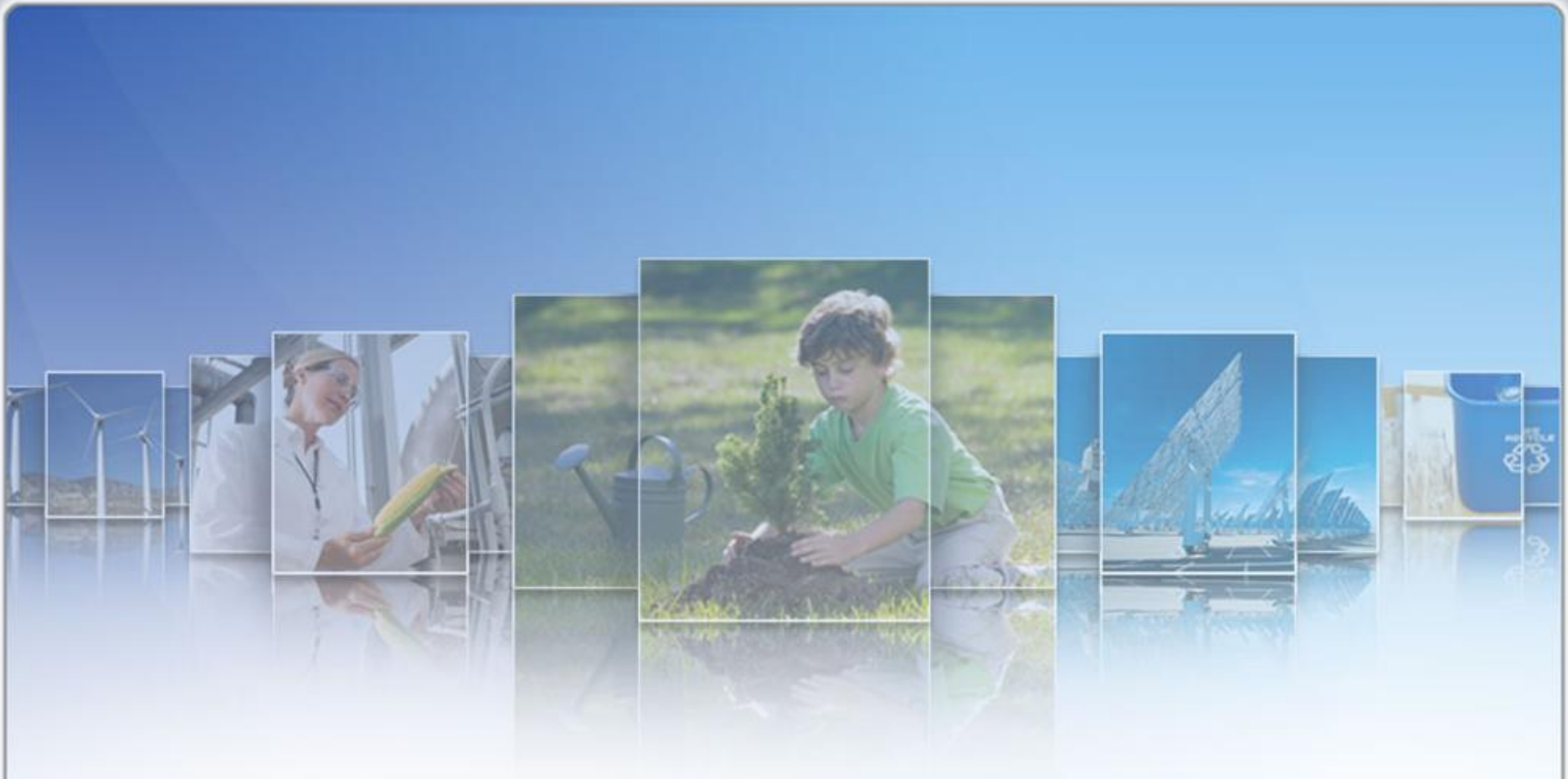


Shaw
Enhanced Mercury Oxidization (EMO™)

30M012011D 01.21.11

Shaw® a world of Solutions™

EMO™ Overview

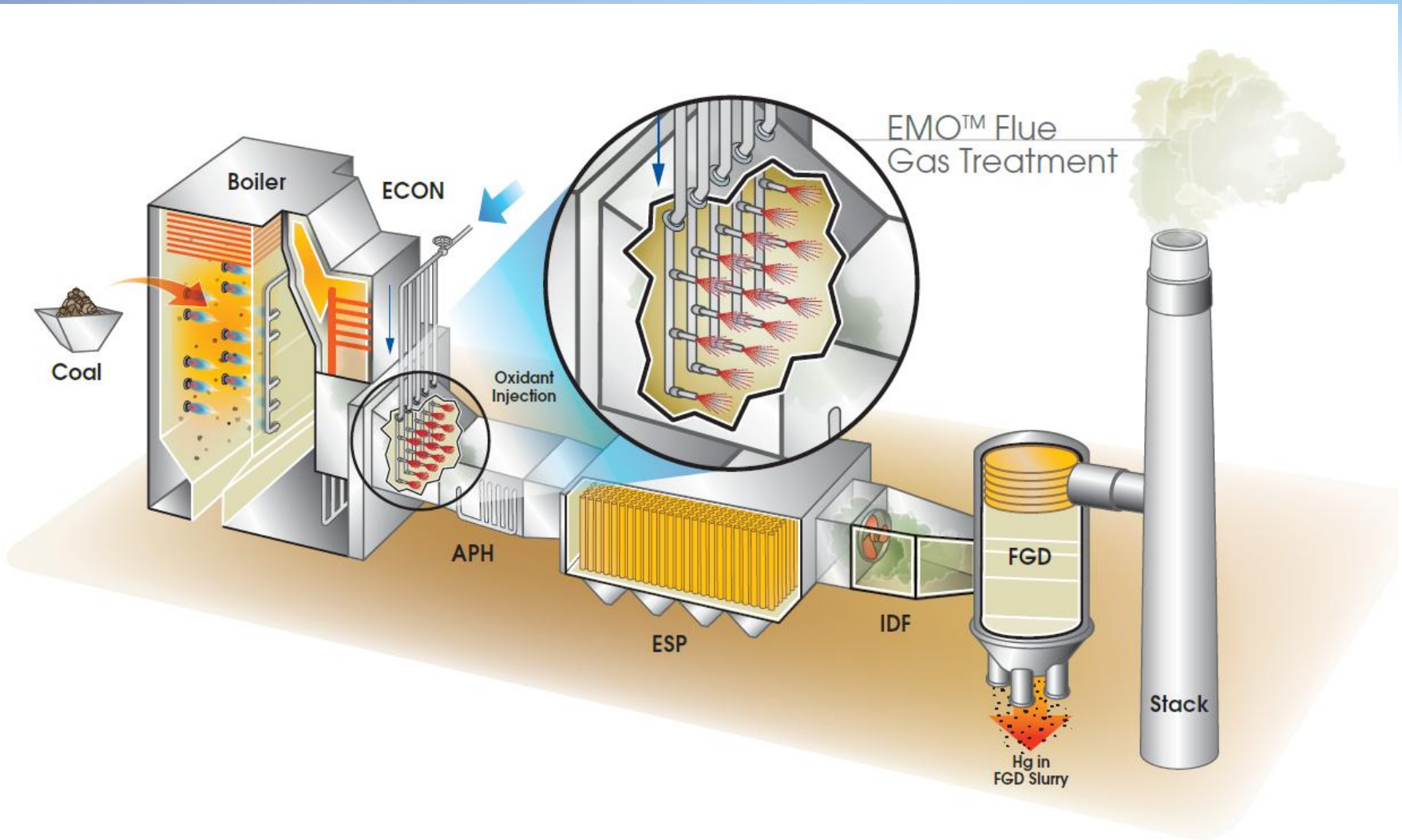
- Post-combustion chemical injection: liquid brominated oxidant
  - Mercury Oxidization: Hg(0) → Hg(2+)
  - Hg(2+) absorption in existing FGD
  - Add powder activated carbon (PAC) or Trona/alkaline sorbent for the non-scrubbed systems
- Generally speaking, the Hg(0)/Hg(2+) ratio at the stacks:
  - **Bituminous:** **40% Hg(0) / 60% Hg(2+)**
  - **Sub- Bituminous:** **90% Hg(0) / 10% Hg(2+)**
- E.g., For a PRB coal-fired application:

PRB coal: 8.5 lb/TBtu → 4.25 lb/TBtu

Need to achieve ~50% Hg oxidation

- Injection location: Economizer outlet (450°F - 800°F)

EMO™ Illustration



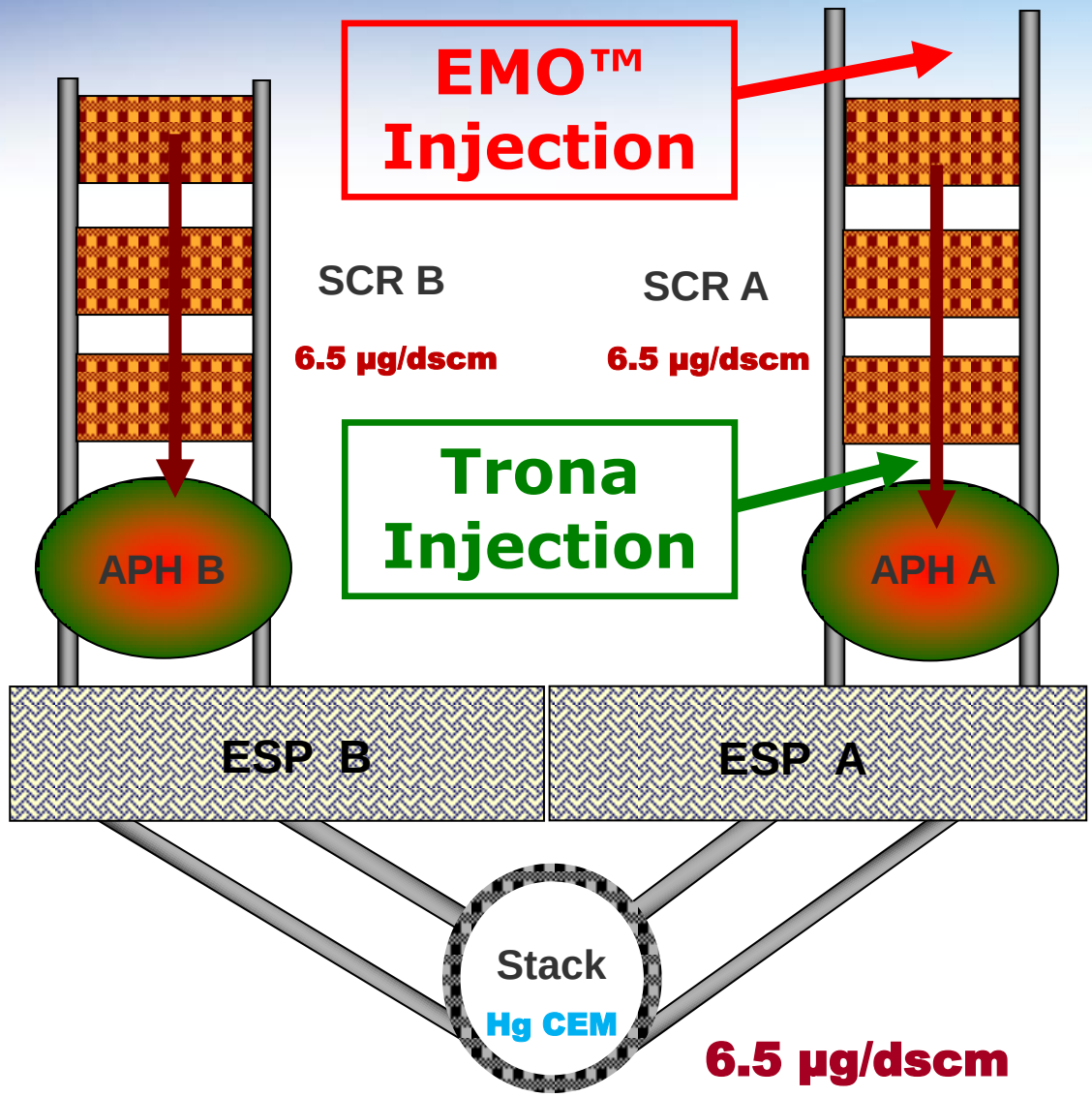
Even Distribution Applying the Effective Chemical

EMO™ System

Application 1: 660 MW PC Boiler

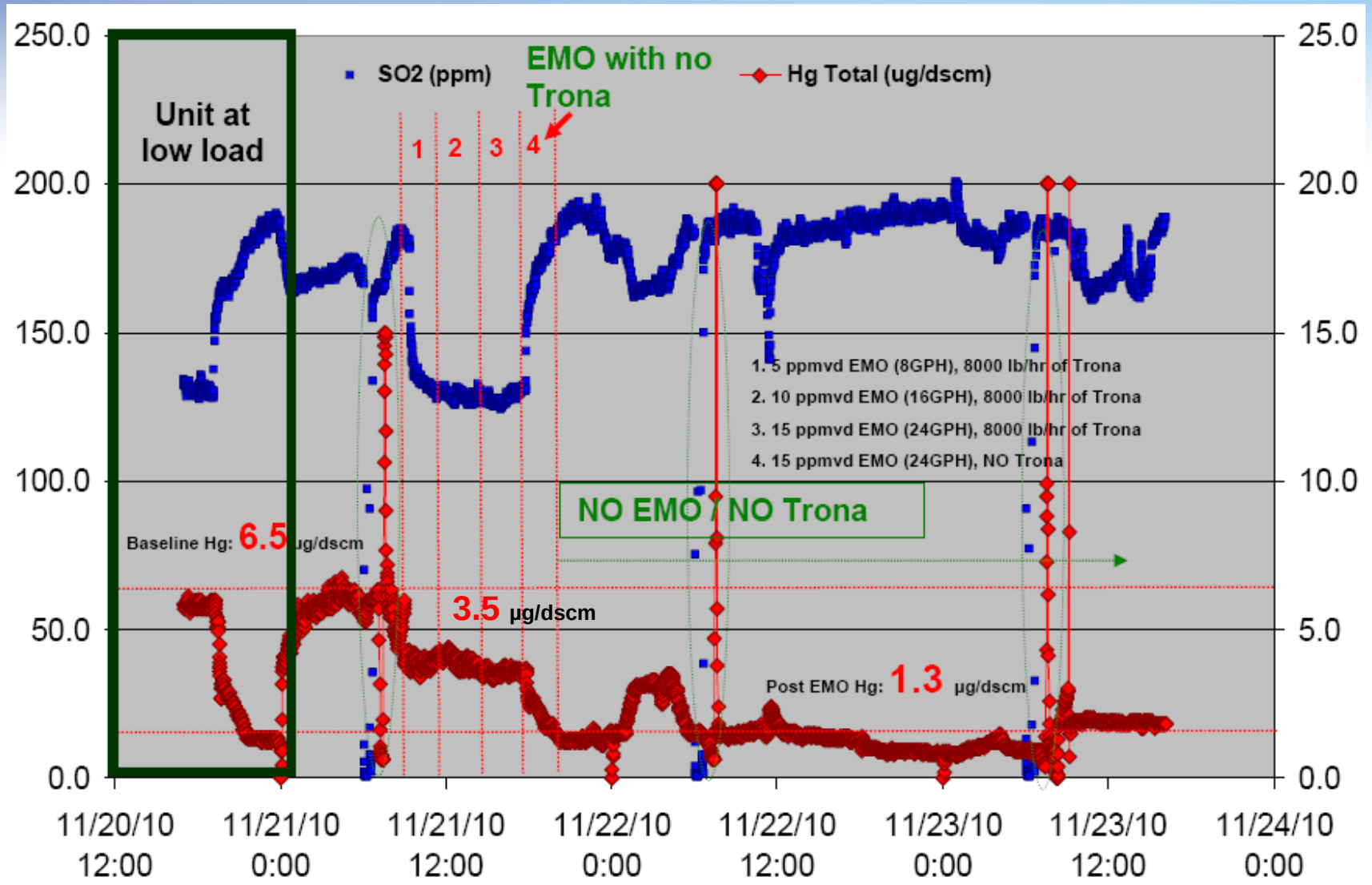
- Sub-bituminous testing results
  - PC Unit burning PRB coal
  - SCR + ESP
- Testing performed on Duct A (one side)
  - Baseline tests
  - Vary EMO™ chemical injection rate at SCR inlet
  - Vary Trona injection rate at the SCR outlet

Application 1: 660 MW PC Boiler



- Flue gas Hg(T) was 6.5 µg/dscm
- > 95% as Hg(0) due to low coal chlorine content

Application 1: 660 MW PC Boiler



30M012011D 01.21.11

Shaw® a world of Solutions™

Application 2: ICI Boiler

- Sub-bituminous coal
  - BFB/HRSG – 150 kpph steam burning PRB
  - SNCR + Trona DSI + FFBH
- Testing performed
  - Baseline tests
  - Vary EMO™ chemical injection rate at the boiler outlet
  - Vary Trona injection rate at the FFBH inlet

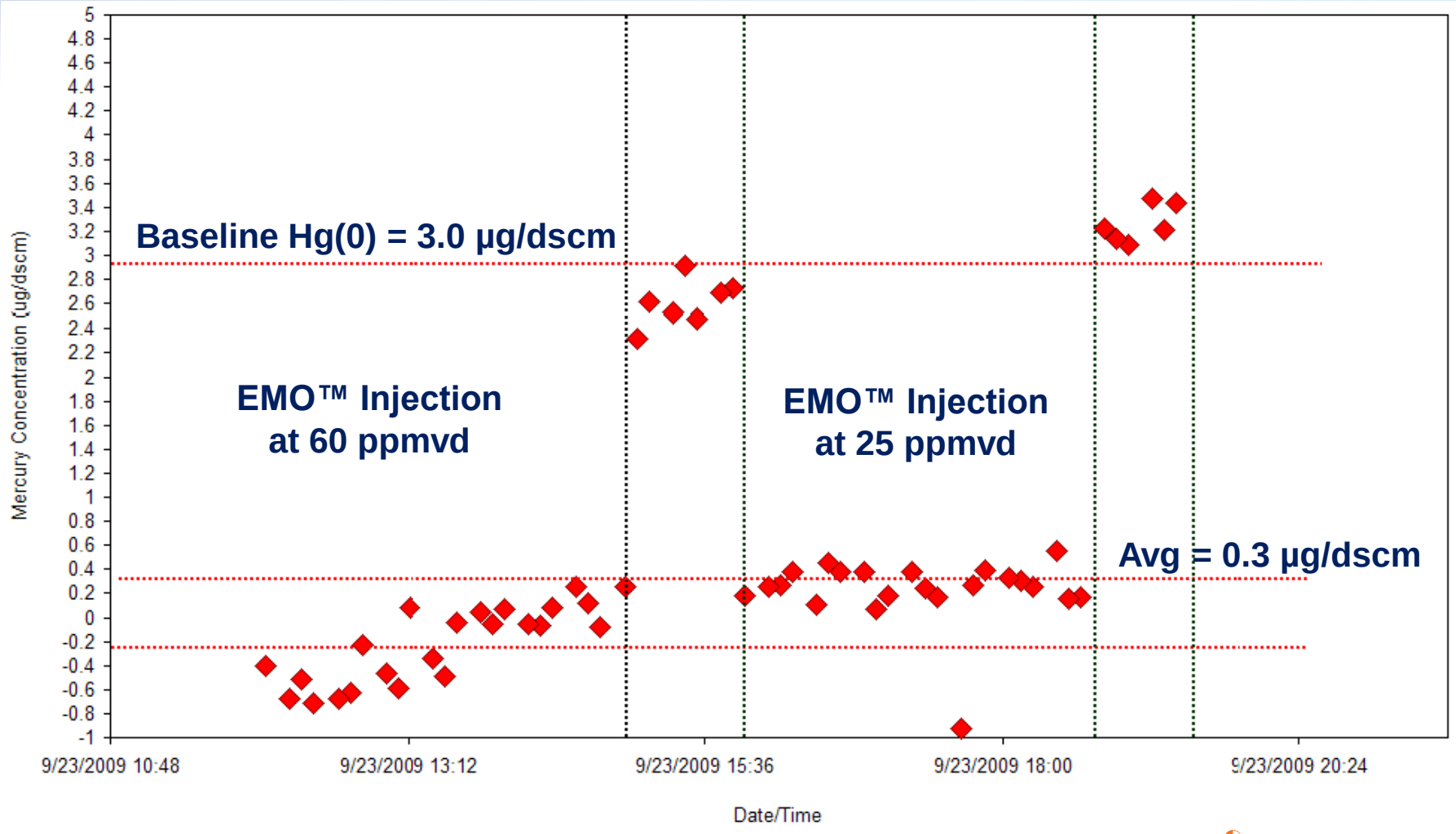
Application 2: ICI Boiler

	Baseline	With Trona	With EMO	%RE
Hg(T) (lb/TBtu)	5.63	5.51	2.64	53%
Hg(0) / Hg(T)	88%	91%	84%	
HCl (lb/MMBtu)	0.054	0.002	---	96%
SO_2 (lb/hr)	27.6	2.5	2.0	> 90%
Trona Rate (lb/MMacf)	0	45	53	
Trona Rate (lb/hr)	0	300	300	
EMO Rate (lb/hr)	0	0	7.0	

Application 3: 350 MW Utility Boiler

- PC Boiler
  - Bituminous coal (CAAP)
  - APH / ESP
- Test Program
  - Baseline
  - Vary EMO™ oxidant injection rates at the economizer outlet

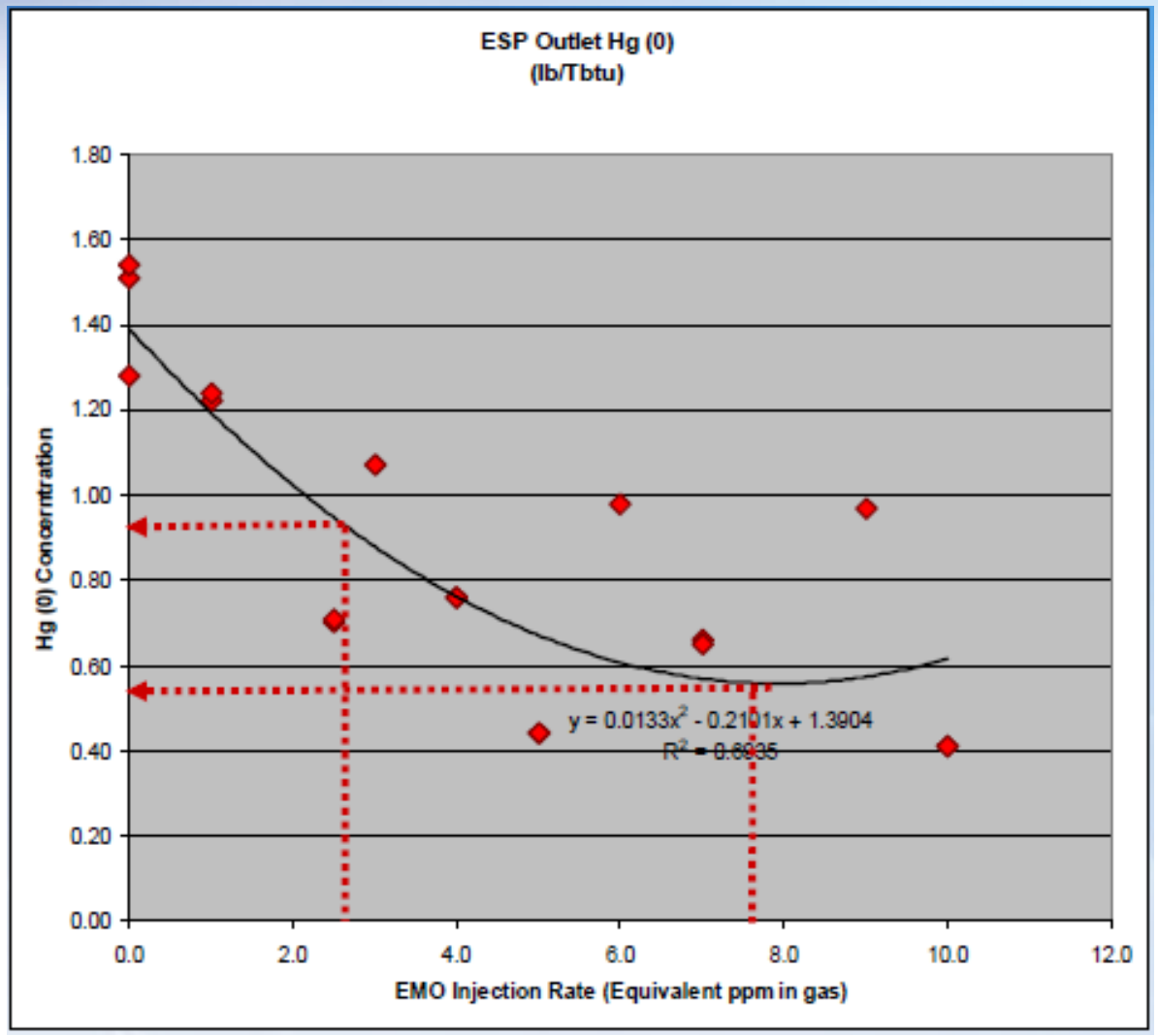
Application 3: 350 MW Utility Boiler



30M012011D 01.21.11

Shaw® a world of Solutions™

Application 3: 350 MW Utility Boiler

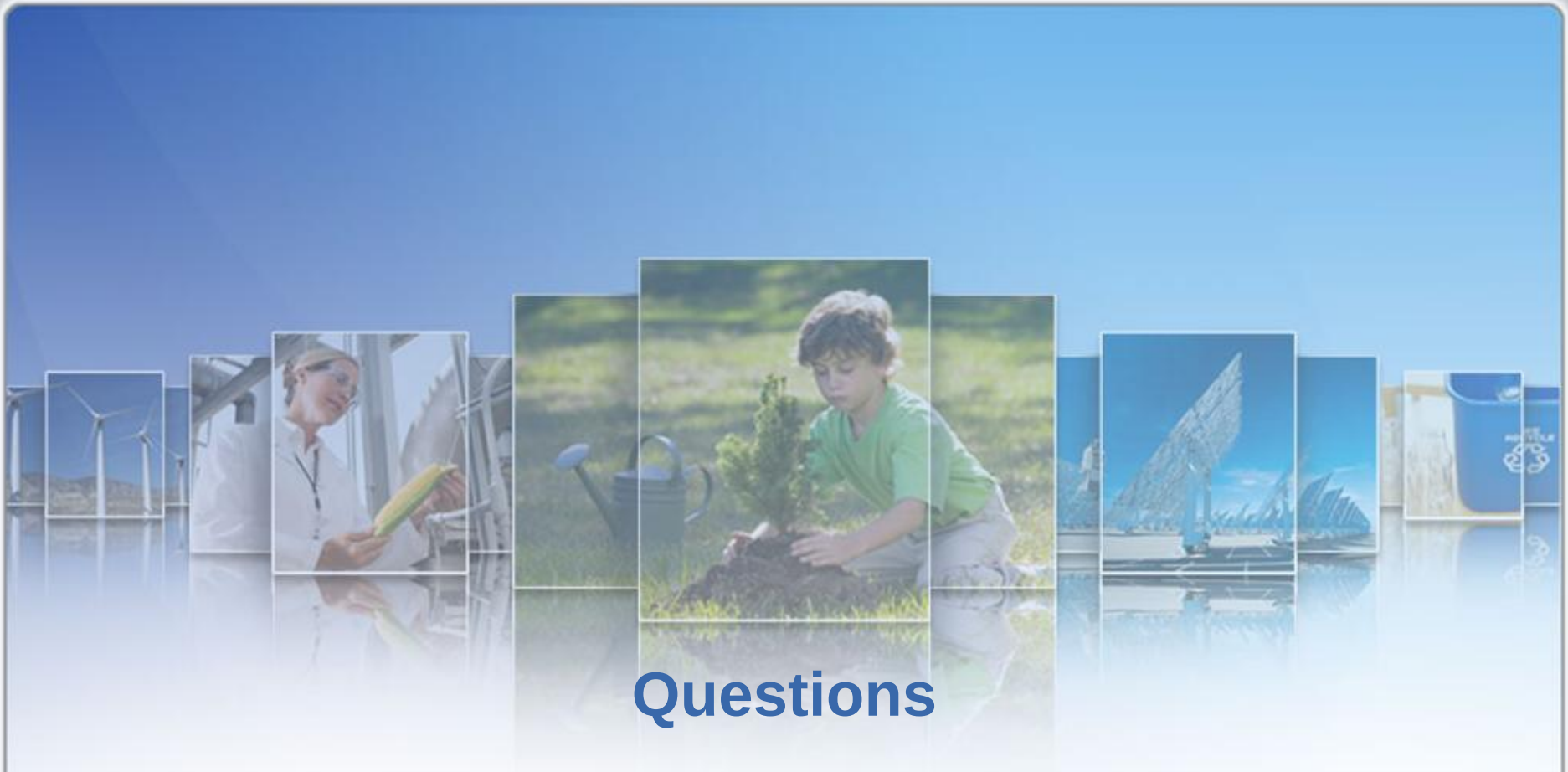


- At 2.5 ppmvd => Hg(0) = 0.95 lb/TBtu

  21.4 lb/hr EMO™ oxidant

- At 7.5 ppmvd => Hg(0) = 0.55 lb/TBtu

  64.3 lb/hr EMO™ oxidant



Questions

Bobby I.T. Chen
Client Program Manager
865.670.2687 (direct)
270.799.6833 (cell)
bobby.chen@shawgrp.com

Terry Marsh
Vice President
865.690.3211 (office)
865.599.3274 (cell)
terry.marsh@shawgrp.com