

REINHOLD ENVIRONMENTAL Ltd.



2012 NO_x-Combustion Round Table & Expo Presentation

February 13-14, 2012, in Columbus, OH / Hosted by AEP

All presentations posted on this website are copyrighted by Reinhold Environmental, Ltd (RE). Any unauthorized downloading, attempts to modify or to incorporate into other presentations, link to other websites, or obtain copies for any other uses than the training of attendees to RE's Conferences is expressly prohibited, unless approved in writing by RE or the original presenter. RE does not assume any liability for the accuracy or contents of any materials contained in this library which were presented and/or created by persons who were not employees of RE.

3 Top Principles for Mercury Removal

2012 NOx - Combustion Roundtable

Mike Rini

Columbus OH, 13 Feb 2012

3 Top Principles for Mercury Removal



1) Oxidize it

- Only oxidized mercury is readily collectable
- Elemental mercury does not collect very well
- Mercury oxidation is facilitated by:
 - Halogens in coal (predominantly Cl, some Br)
 - Additives (e.g., calcium bromide)
 - SCR (oxidation catalyst)

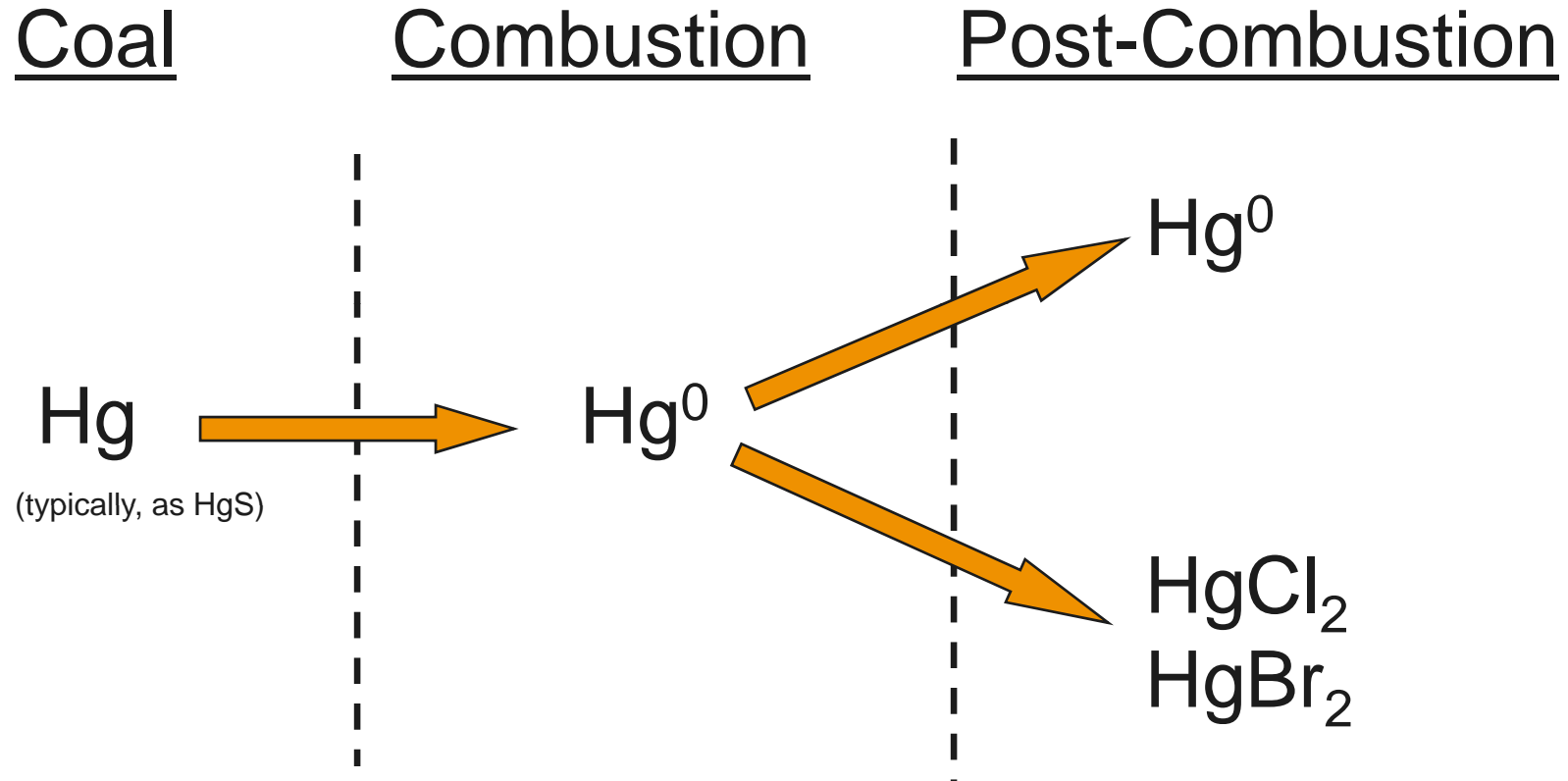
2) Provide capture sites for the oxidized mercury

- UBC/LOI
- PAC
- High surface area dust (ash/DFGD, etc)
- WFGD (oxidized mercury is water soluble)

3) Promptly remove captured mercury from the APCD system

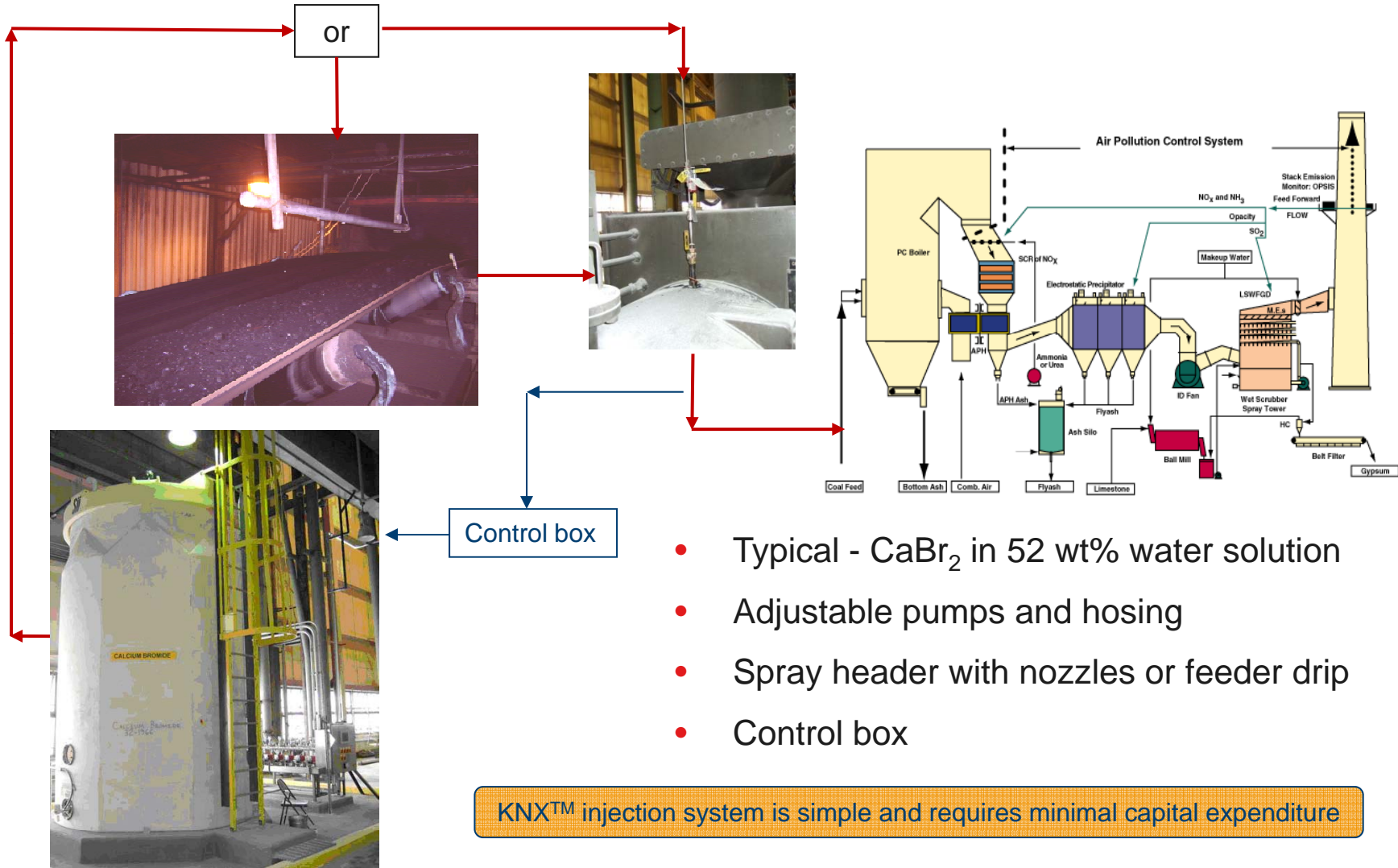
- avoids chemical reduction and re-emission

The Fate of Mercury



Oxidized Mercury is Collectable on Fly Ash and Carbon

Design of the KNX™ Application System

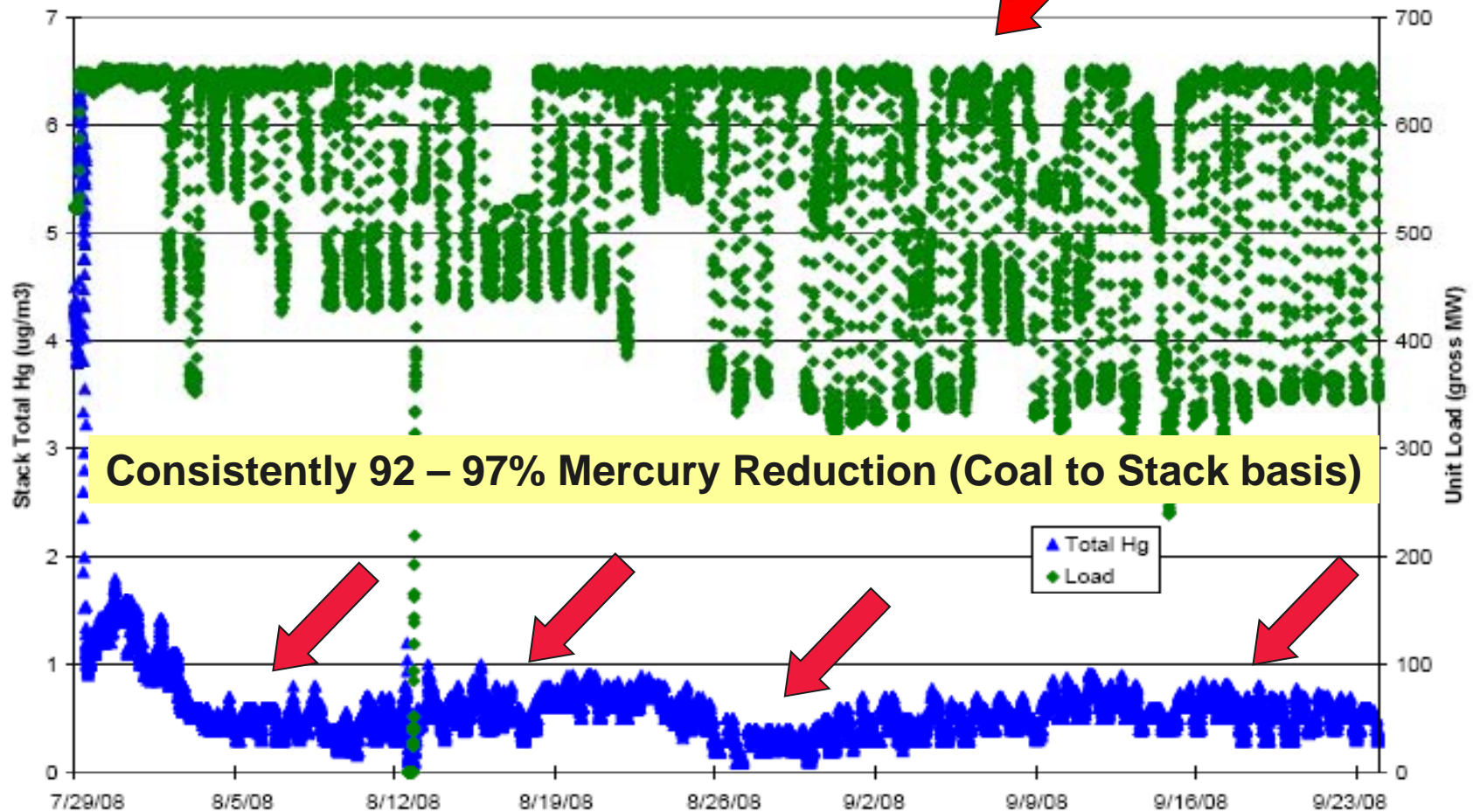


High Hg Removal at Low Dosage - Pleasant Prairie

Fuel = PRB
APC = SCR, ESP, WFGD

KNX Test Results
25 ppm Br on Coal

Boiler Load



>3000 MW of Commercial KNX[™] Operations - TEP - 30 Jan 2012 - P 5

© ALSTOM 2011. All rights reserved. Information contained in this document is indicative only. No representation or warranty is given or should be relied on that it is complete or correct or will apply to any particular project. This will depend on the technical and commercial circumstances. It is provided without liability and is subject to change without notice. Reproduction, use or disclosure to third parties, without express written authority, is strictly prohibited.

Keys to Mercury Retention in a WFGD



- Limit flyash carry over
 - Flyash supplies metallic ions that reduce oxidized mercury

- Moderate sulfite levels
 - Sulfite promotes stable mercury compounds
 - High sulfite levels promote re-emission

- Moderate Chloride levels
 - Chlorides promote stable mercury compounds

- Significant captured Mercury reports to the gypsum fines. Remove captured mercury from WFGD to avoid reducing reactions

Conclusions



- Several KNX[™] systems have been in commercial operation for over 2 years.
- The effectiveness of KNX and its rapid response to fuel Hg and boiler load variations have been demonstrated.
- The combination of pre-combustion bromide addition and non-brominated activated carbon injection (ACI) reliably controls Hg emissions in ESPs.
- KNX[™] technology is based on pre-combustion bromide addition which is patent protected and exclusively marketed by ALSTOM in the US and Canada.

www.alstom.com/power

POWER | **ALSTOM**

Mercury Oxidation Chemistry



- In the flame, all Hg is elemental (Hg^0). Cl and Br from the coal form HCl and HBr.
- On cooling (starting around 1000 °C):
$$4\text{HCl} + \text{O}_2 \rightarrow 2\text{H}_2\text{O} + 2\text{Cl}_2$$
$$4\text{HBr} + \text{O}_2 \rightarrow 2\text{H}_2\text{O} + 2\text{Br}_2$$
- Cl_2 (but not Br_2) is consumed by SO_2
$$\text{SO}_2 + \text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{SO}_3 + 2\text{HCl}$$
- Result is that although total Cl in the coal is far greater than total Br, after combustion, much more Br_2 remains compared to Cl_2
- So that elemental Hg is oxidized by Br_2 to form HgBr_2
- In low Chlorine coals (e.g. PRB), addition of Bromine is critical to enhance Hg oxidation
- Bromine is also valuable for bituminous coals to drive additional mercury oxidation