

COST EFFECTIVE EMISSIONS & COST REDUCTION FOR COAL POWER

Case studies summary & projection

Heeelp!
Can't go without it
and it's difficult with it!

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COAL POWER FACTS (2019)

- 2 mil MW coal power globally with 50+% in one country.
- 1,600 plants under construction in 62 countries.
- Phasing out coal in USA and EU with marginal effect.
- Plant emissions remain global issue.
- Plants lack emissions control systems on lack of capital.

CONCEPT

- Know-how is developed for innovative tuning of boiler & cooling tower.
- Moderate means needed to implement.
- Economic gain paying for emission control systems without affecting plant economics.
- Concept proven at 4 case studies.

CASE STUDY 1: BOILER COMBUSTION TUNING

Project

- 600MW unit boiler combustion tuned in Indonesia in 2016.
- Boiler found well maintained with combustion settings kept since commissioning in 1997.
- \$60/t sub-bituminous coal price.
- Tuning job completed within 24h with moderate means.
- UN sponsored project covering 3 Asian countries*.

CASE STUDY 1: BOILER COMBUSTION TUNING

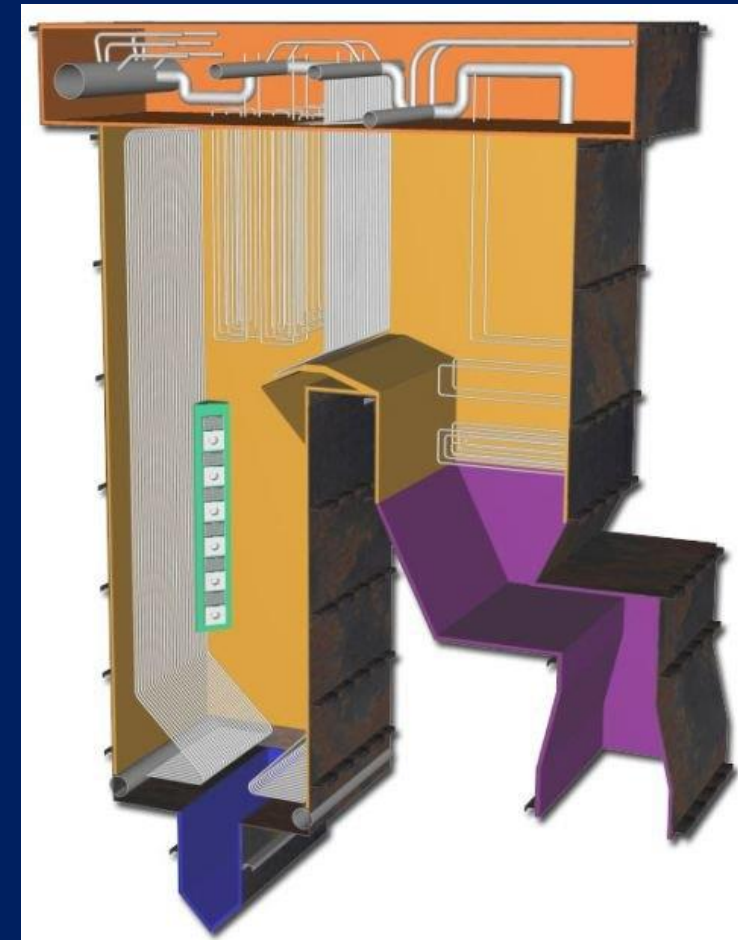
Outcome

- Innovative technique resulted in:
 - 35,200 t/y reduced coal usage.
 - \$2.1 mil/y economic gain (coal price in 2016).
 - 67,000 t/y reduced CO₂ emissions.
 - (\$1.8 mil/y in carbon credits where in place).
- Replicable at other locations.

CASE STUDY 2: BOILER THERMODYNAMICS SOFTWARE

Existing constrains

1. Simulation of boiler geometry & operation parameters calls for extensive expertise.
2. Existing tools complex and costly requiring dedicated experts.
3. Consequently plants don't benefit from such tools though needed.



CASE STUDY 2: BOILER THERMODYNAMICS SOFTWARE

Solution

- Dedicated software is developed for plant operators.
- Incorporates latest findings in heat transfer theory.
- Accurate & reliable results.
- Handles every power boiler in existence.
- User friendly graphical interface.
- Available online: www.boilerdesignsoftwareonline.com

CASE STUDY 2: BOILER THERMODYNAMICS SOFTWARE

Field test

- Boiler from Case study 1 calculated in advance.
- 90-95% predicted combustion tuning potential confirmed.
- Further tuning potential detected doubling gain from combustion tuning*.

CASE STUDY 2:

BOILER THERMODYNAMICS SOFTWARE

Field test - cont.

- Case study 1 plant's 8 boilers total tuning potential:
 - 500.000 t/y reduced coal usage.
 - \$30 mil/y economic gain created (2016 coal price).
 - 950.000 t/y reduced CO₂ emissions.
 - (\$25 mil/y in carbon credits where in place).
- Pays for plant's emissions control system without affecting economics.

4025MW SURALAYA POWER PLANT, INDONESIA



BOILER THERMODYNAMICS SOFTWARE

Application in Vietnam

- Industrial boiler module used by leading Vietnam boiler manufacturers.
- Online version development co-financed by UN project in Vietnam.
- Vietnam's two leading boiler experts appointed to assist*.

BOILER THERMODYNAMICS SOFTWARE

Software training class in Hanoi

The banner features logos for the Vietnamese government, GEF (Global Environment Facility), and UNIDO. The text on the banner includes:
Dự án "Thúc đẩy việc sử dụng và vận hành nồi hơi công nghiệp hiệu quả năng lượng tại Việt Nam"
Project "Promotion of Energy Efficient Industrial Boilers Adoption and Operation Practices in Vietnam"
KHÓA ĐÀO TẠO
HƯỚNG DẪN SỬ DỤNG PHẦN MỀM THIẾT KẾ NỒI HƠI
TRAINING COURSE
BOILER DESIGNING SOFTWARE OPERATION
Nhà Khách Quốc hội, Hà Nội - 03 & 04 tháng 04 năm 2018
National Assembly's Guest House, Hanoi - April 03rd & 04th, 2018



BOILER THERMODYNAMICS SOFTWARE

Software training class in Hanoi



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Project "Promotion of Energy Efficient Industrial Boiler Adoption and Operating Practices in Vietnam"

**KHÓA ĐÀO TẠO
HƯỚNG DẪN SỬ DỤNG PHẦN MỀM THIẾT KẾ NỒI HƠI**

TỔNG QUẢN LÝ

BOILER DESIGN

OPERATION



BOILER TUNING & SOFTWARE

Summary

- Results delivered immediately.
- No boiler stoppage to implement.
- No capital investment.

CASE STUDY 3: COOLING TOWER EVALUATION

Existing constraints

- Standard performance test established practice.
- Inspection based on statistical methods*.
- Equipment upgrade suggested though often not needed.
- In-depth analysis not carried out*.
- Part of tuning potential goes undetected.

CASE STUDY 3: COOLING TOWER EVALUATION

Solution

- Dedicated algorithm is developed.
- Autonomous mobile unit programmed and deployed:
 1. Measures key operation parameters.
 2. Identifies areas with anomalies.
 3. Draws a map & assesses gain.
- Final development co-financed by EU grant.

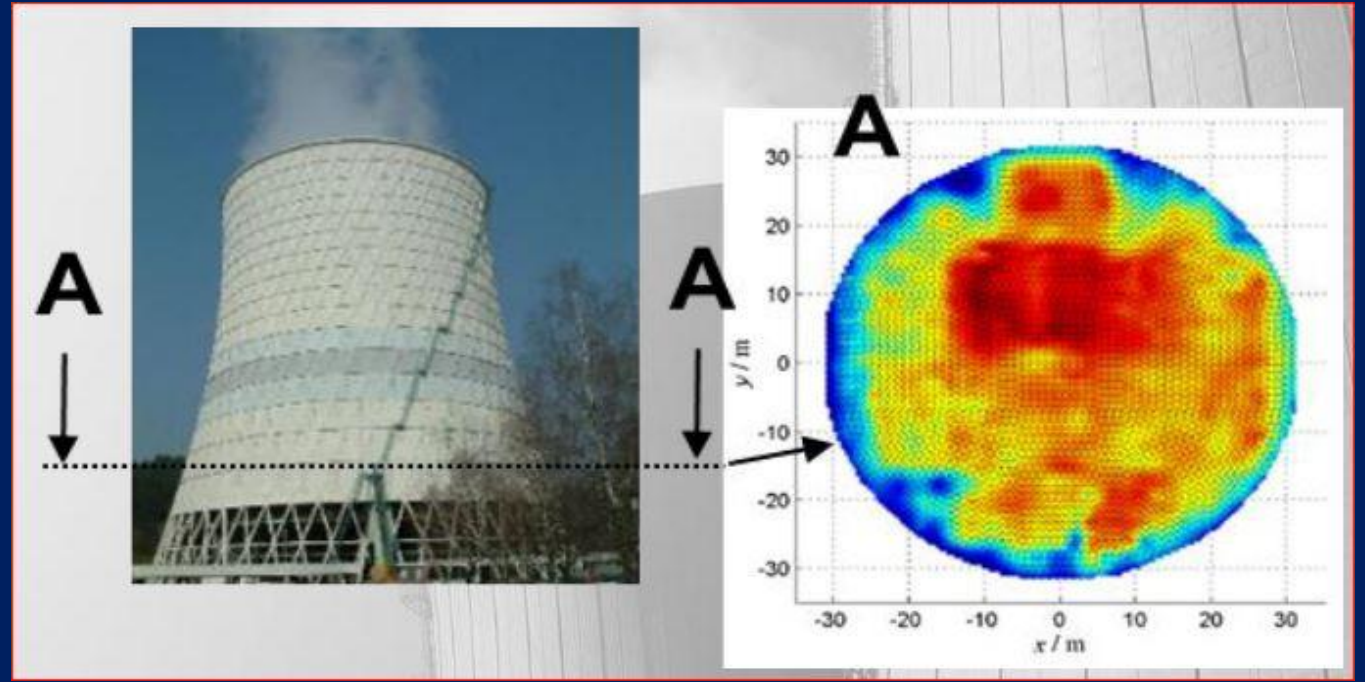
CASE STUDY 3: COOLING TOWER EVALUATION

Field test

- Technology deployed at several plants in EU (800-2,000MW, coal fired and nuclear).
- Equipment found well maintained.
- 0.3–1% system efficiency increase observed.
- 1% system efficiency rise for Case study 1 boiler doubles combustion tuning effect.

CASE STUDY 3: COOLING TOWER EVALUATION

Deployment images



CASE STUDY 4: BOTTOM ASH HANDLING

Existing constraints

- Falling fused ash chunks result in boiler stoppage.
- Unburned in bottom ash can reach up to 20+%.
- Ash quenching.
- Outside air enters boiler through deasher.
- Existing technologies moving grate based.

CASE STUDY 4: BOTTOM ASH HANDLING

New technology

- Integrates tasks of two conventional technologies:
 1. Bottom ash extraction.
 2. Bottom ash afterburning.
- Carries out both tasks simultaneously or individually.
- Less complex than conventional technologies for individual tasks.

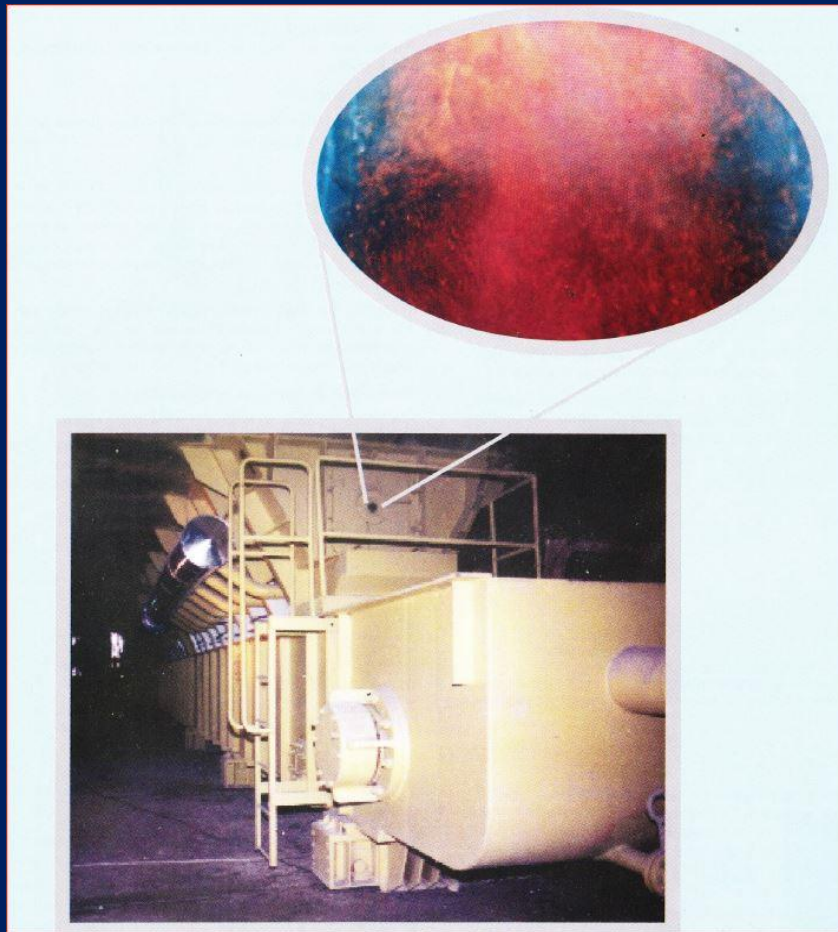
CASE STUDY 4: BOTTOM ASH HANDLING

Technology highlights

1. No moving grate:
 - Minimum moving parts.
 - Withstands impact of falling fused ash chunks.
2. Sealed off operation.
3. No ash quenching.
4. No changes to boiler and burners to install.
5. Accepts additional fuel-RDF (under development)*.

CASE STUDY 4: BOTTOM ASH HANDLING

Deployment images



CONCEPT IMPLEMENTATION PROJECTION: 100.000MW COAL POWER

Assumptions:

1. Boiler & cooling tower tuning potential from case studies.
2. 50% plants with cooling towers.
3. \$60/t sub-bituminous coal price.

CONCEPT IMPLEMENTATION PROJECTION: 100.000MW COAL POWER

- Benefits (likely conservative):
 - **11.3** mil t/y coal usage cut (**16.5** mil/y with 4% RDF).
 - **\$680** mil/y economic gain (**\$1B**/y with 4% RDF).
 - **22** mil t/y CO₂ emissions cut (**31.5** mil/y with 4% RDF).
 - (**\$580** mil/y in carbon credits - **\$850** mil/y with 4% RDF).
- Pays for desulfurisation & deNO_x systems!

ACHIEVING HIGHEST EFFECT

- Know how transfer for in-house action as needed.
- Fast-track nation-wide implementation follows.
- Permanently optimized plants result.

SUMMARY

- Plant emissions manageable at cost.
- Securing capital for emissions control most challenging.
- Concept in place for plants to generate capital in-house.
- Advanced boiler and cooling tower tuning expertise developed generating economic gain.
- Plants take multi-year loans upon implementation.
- Plant economics not affected.

CONCLUSION

Significant benefits resulting from how power plants are run:

1. Economic gain created.
2. Environmental footprint improved.
3. Political gains*.

THANK YOU!

www.thermalpower.info

