



GE solutions for NOx compliance and increased availability for WtE / Biomass plants

Gerhard Heinz

Panndagarna | 6 April 2017

GE Power – Global technology provider with strong roots in Sweden

GE Power:

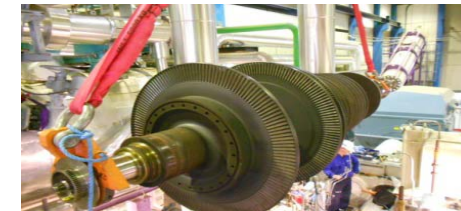
- Alstom Power is GE Power since 2015, a part of General Electric group with of over 300,000 employees in 150 countries

Our vision

- To develop, deliver and maintain plant systems that meet the market demands for environmental performance, availability and low Electricity & heat production costs.

Some facts

- 125 years as plant & service provider for many of the Swedish power plants
- Large focus on Boiler, Environmental, Steam turbine, Gas turbine and Generators
- A global network of Research & Development and engineering resources



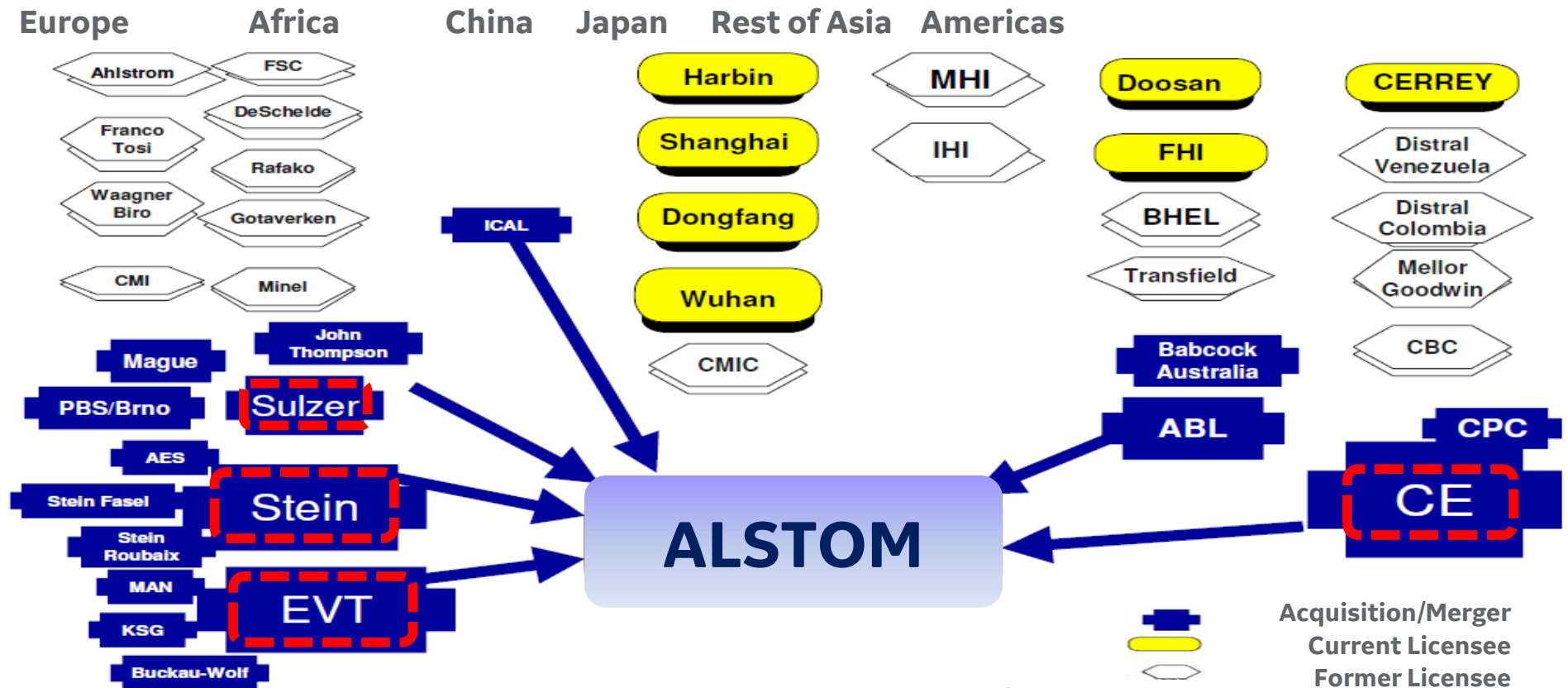
Gerhard Heinz/GE 2017 04 06

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

© 2016 General Electric Company - All rights reserved

ALSTOM legacy - History in Boilers

Global Technology Leadership



GE Proprietary Information - The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE.

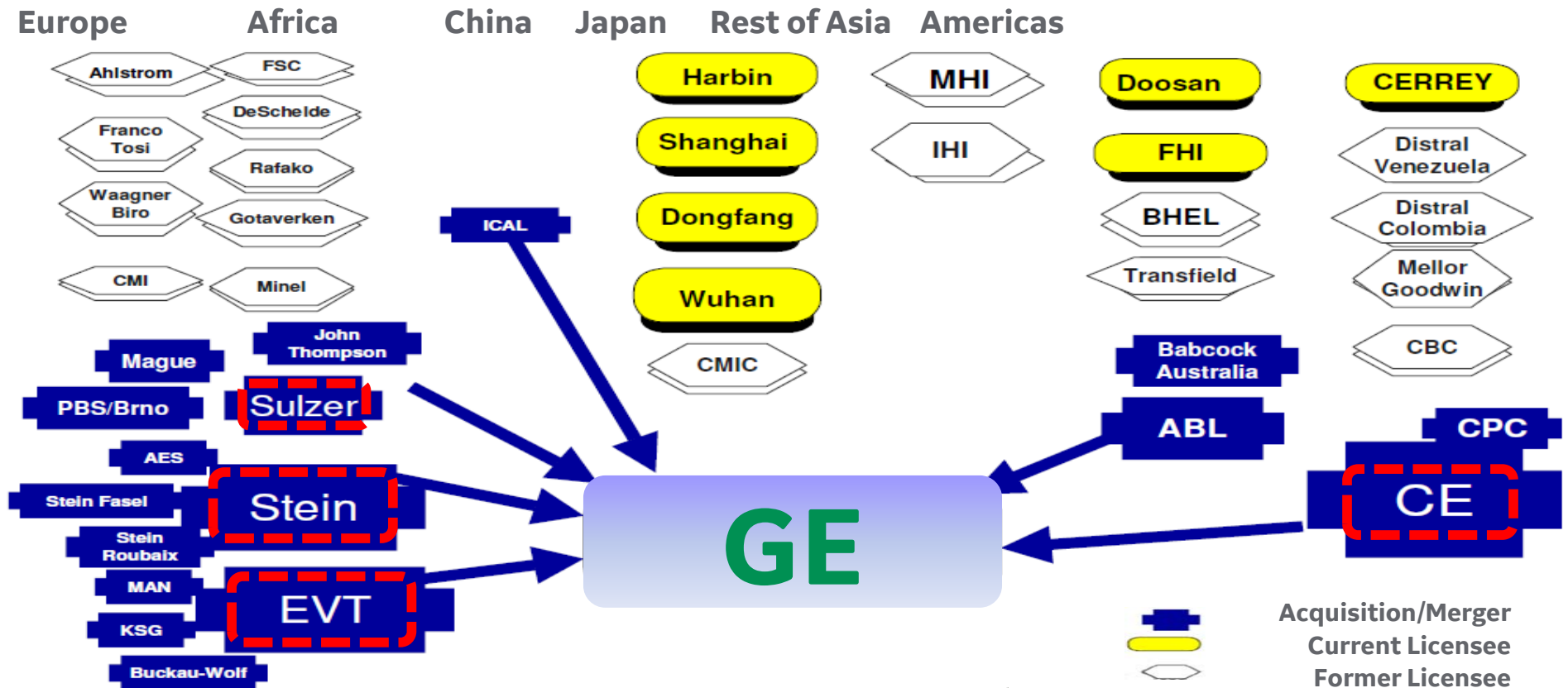


Gerhard Heinz/GE 2017 04 06

© 2016 General Electric Company - All rights reserved

GE TODAY - History in Boilers

Global Technology Leadership



GE Proprietary Information - The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE.



Gerhard Heinz/GE 2017 04 06

© 2016 General Electric Company - All rights reserved

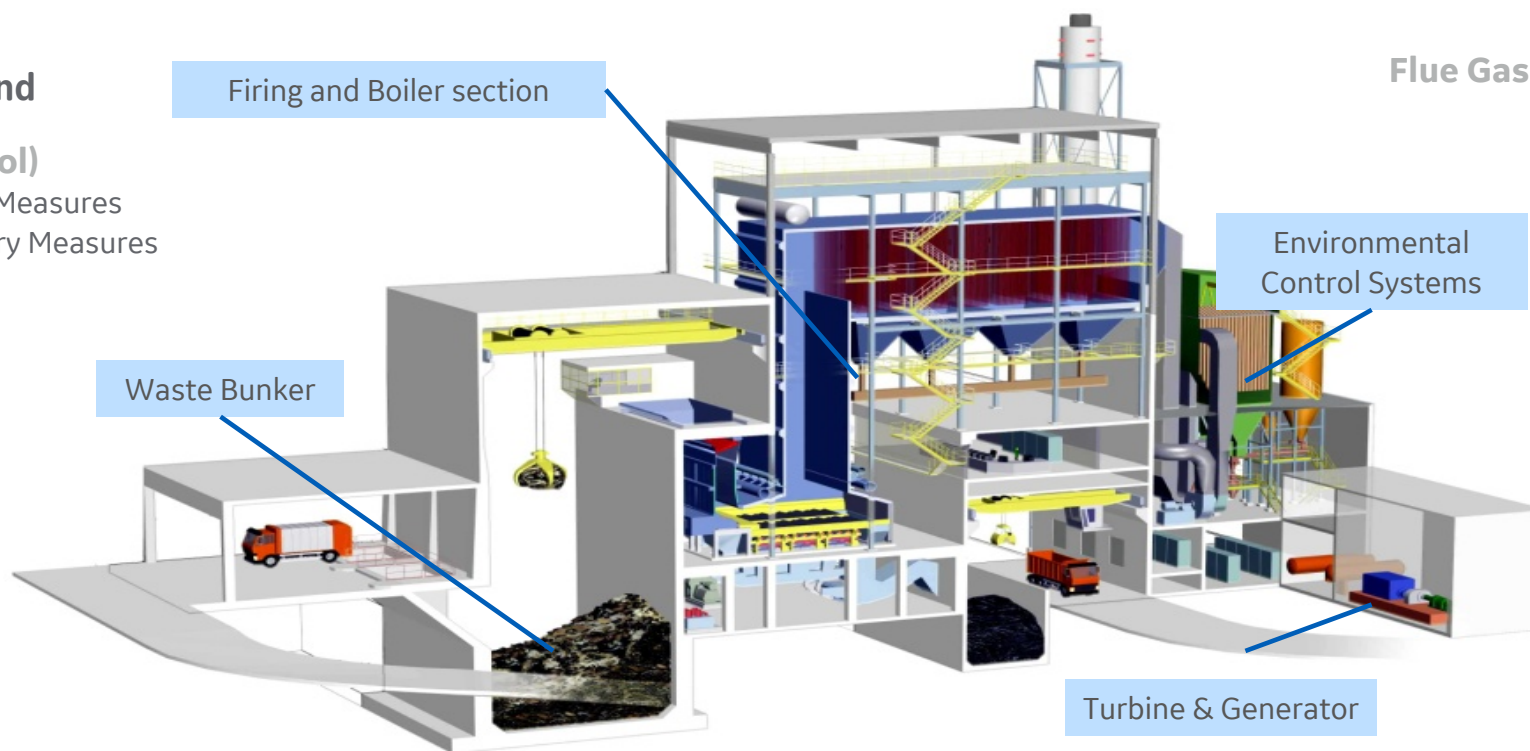
WtE Thermal Block with Flue Gas Cleaning

GE is offering Plant solutions for new WtE Plants and Services and upgrades on existing WtE Plants covering Boiler and Flue Gas Cleaning Technology

Boiler Island

NO_x control)

- Primary Measures
- Secondary Measures USNCR



Flue Gas Desulphurization (FGD)

- Wet FGD
- Dry FGD

Particulate Control

- Fabric Filter
- Electrostatic Precipitators

INTEGRATED OFFERING

- Integrated packages (EP)
- Full turnkey (EPC)



Gerhard Heinz/GE 2017 04 06

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

© 2016 General Electric Company - All rights reserved

New Plants and Services on installed fleet



Overview - GE Boiler and Combustion Technology Service Products and new Plant design

Maintenance Costs

Emissions Compliance

Reliability

Operational Costs

Availability

Performance Improvements

Inspections/ Assessments

Flexibility



Steam Boiler

Technical specification & Design

Steam Flow :	50 t/h - 120 t/h for a single boiler
Steam outlet pressure:	up to 70 bar
Steam outlet temperature:	up to 450 °C
Boiler design :	3-pass tailend
Waste Capacity :	8 t/h - 32 t/h for a single boiler
Firing system :	Modularized air cooled grate with 4 air control zones per grate line
Fuel feeding :	Water cooled Inlet chute 1 Ram feeder per grate line
Heating panel cleaning :	Left & right sided Rapper devices per bank
Maintenance :	Easy replacement of heating panels via mobile crane
Service :	Optimized periods by Digital operation support

GE Proprietary information - The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE



Gerhard Heinz/ GE 2017 04 06

Services to Waste-to-energy plants

Engineering & Design

Dedicated engineering team to address all customer needs and specific requirements

Long term service agreements

Meeting customer requirements of long term plant life through optimal service solutions and long lasting partnerships

Upgrade & Retrofit

Latest requirements compliance and efficiency as per latest technology and beyond

Digital services

From digital audit to Asset Performance Management for best plant performance

Lab testing

Dedicated testing facility to analyze customers' own samples for optimized and customized solutions

Spare parts management

Innovative solutions for parts management and accessibility to dedicated channels

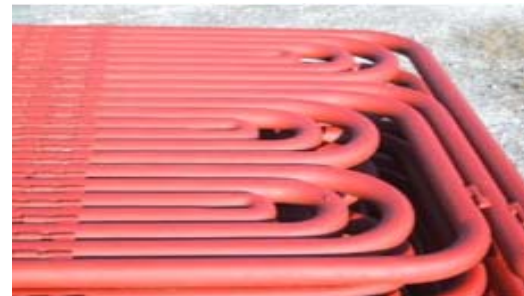


Boiler Service on WtE Plants

Products

- Pressure Part, typical repairs
- Grate-firing & Ash removal system
- Emission reduction USNCR NOx solutions
- Innovative solutions [e. g. AmStar]
- Spare parts business, typical spares

Heating Surfaces



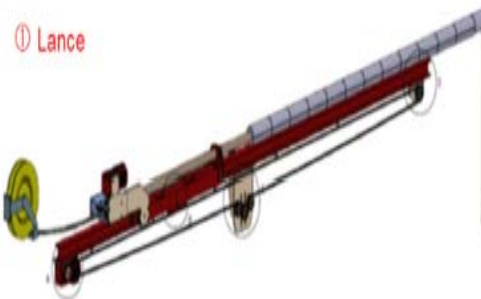
Membrane Walls



Grate Firing



USNCR



AmStar



Headers



Gerhard Heinz/ GE 2017 04 06

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

© 2016 General Electric Company - All rights reserved

Secondary NO_x Measures USNCR

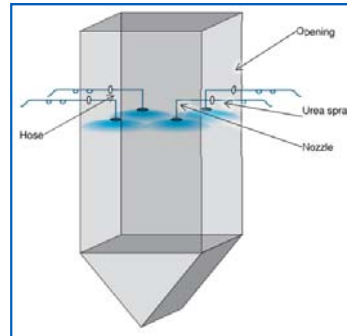


Secondary NOx Control

With Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR)

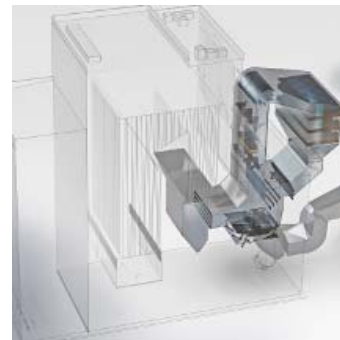


Selective Non-Catalytic Reduction (SNCR/USNCR)



- Power and industrial applications
- Umbrella-SNCR based on a proprietary injection design
- NH_3 reagent directly in the boiler at temperatures of $850 \sim 1100 \text{ }^\circ\text{C}$
- Removal efficiencies up to 50 %
- NH_3 slip $< 10 \text{ mg/Nm}^3$

Selective Catalytic Reduction (SCR)



- Power and industrial applications
- Various SCR configurations (high-, low dust and tail-end)
- Use of a catalyst and the NH_3 reagent at a temperatures around $300 \sim 430 \text{ deg C}$
- Experience with various catalyst's structures
- Removal efficiencies up to 90 %
- NH_3 slip $< 5 \text{ mg/Nm}^3$

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

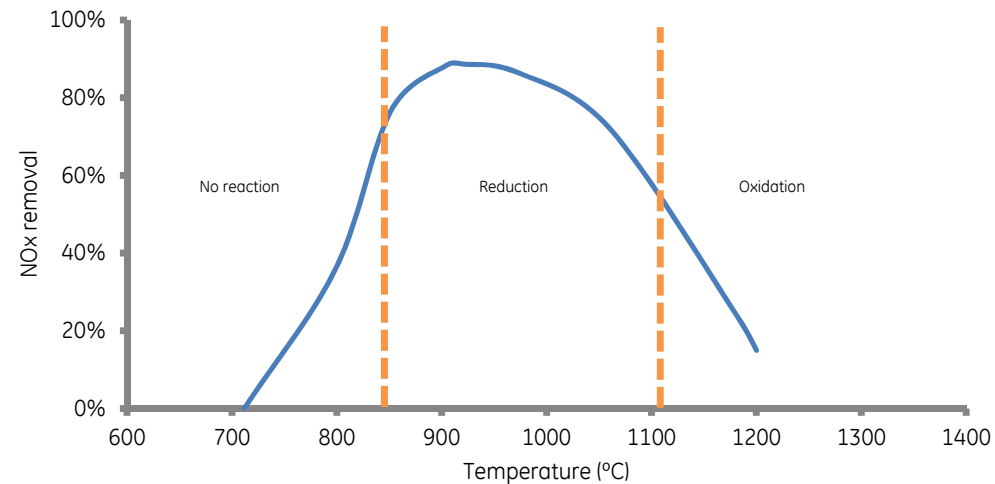


Gerhard Heinz/ GE 2017 04 06

© 2016 General Electric Company - All rights reserved

The SNCR process

- In the SNCR process, NO_x molecules are reduced by either ammonia or urea. Sum of reactions :
- $4 \text{NO} + 4 \text{NH}_3 + \text{O}_2 \leftrightarrow 4 \text{N}_2 + 6 \text{H}_2\text{O}$
- $4\text{NO} + 2\text{CO}(\text{NH}_2)_2 + \text{O}_2 \rightarrow 4\text{N}_2 + 4\text{H}_2\text{O} + 2\text{CO}_2$
- The process is sensible to:
 - **Temperature and residence time.** The reagent must remain at in the correct temperature window (right) long enough, **at all boiler loads**
 - **Flue gas penetration** by the reagent.

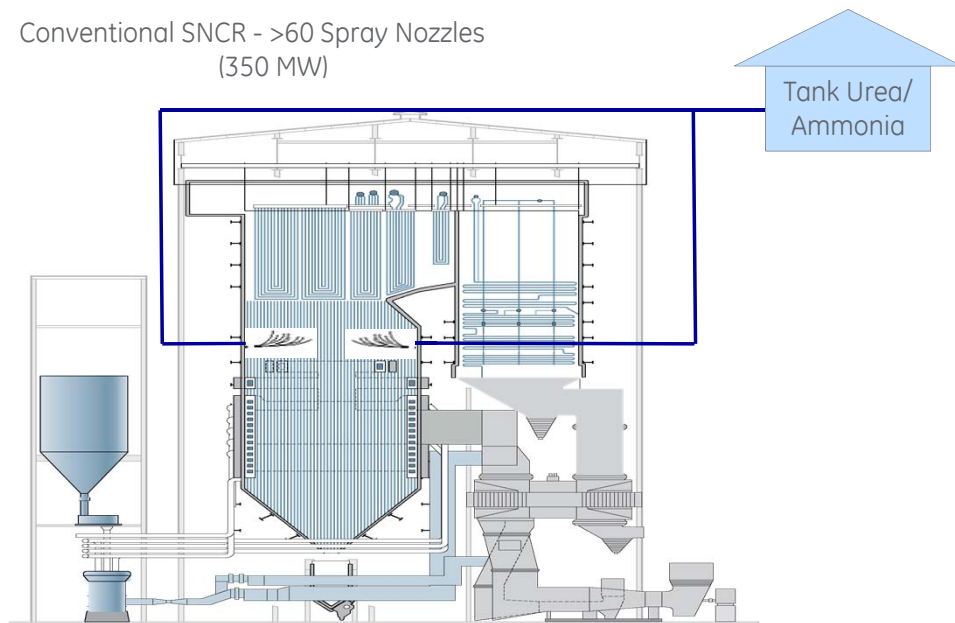


Effect of temperature on NO_x reduction.
SNCR reactions best occur between 870°C and 1,150°C. Actual window is reagent dependent



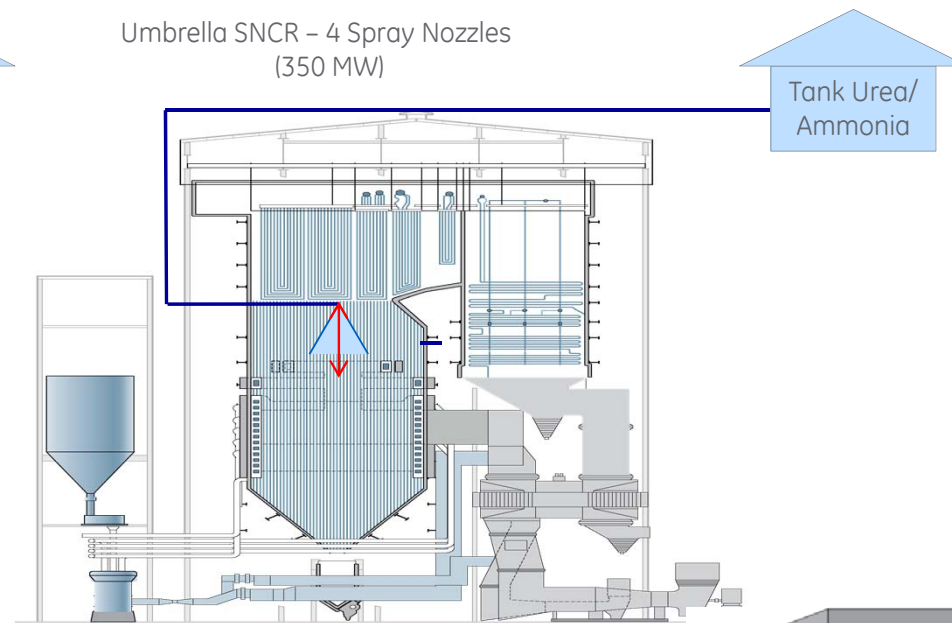
Types of SNCR

Conventional SNCR - >60 Spray Nozzles
(350 MW)

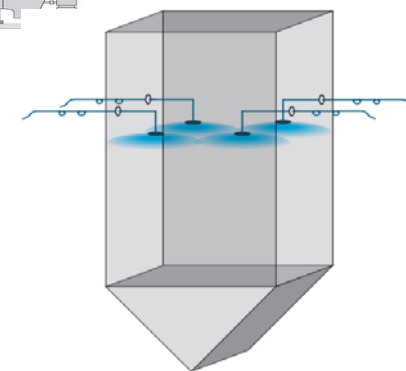


Traditional SNCR
Uses lances to inject urea
via multiple wall nozzles
-> limited penetration

Umbrella SNCR - 4 Spray Nozzles
(350 MW)



Umbrella SNCR
New Patented method
of injecting Urea
-> full penetration

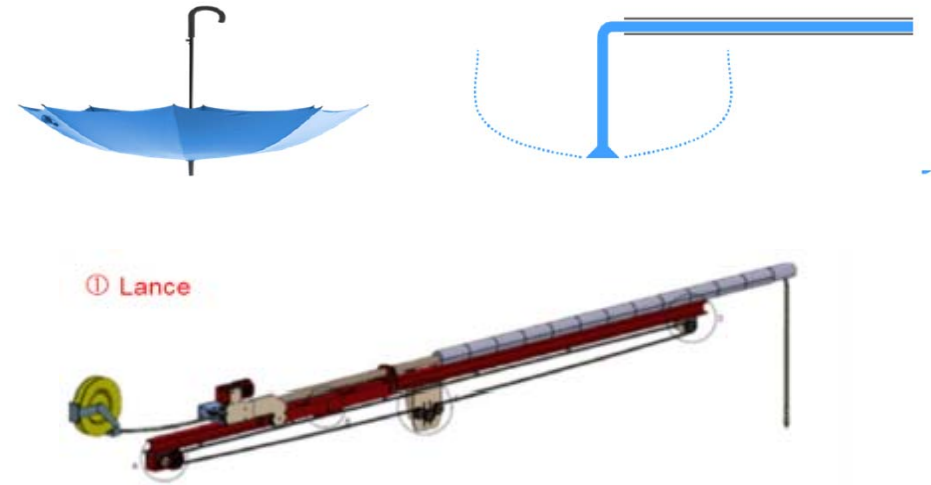
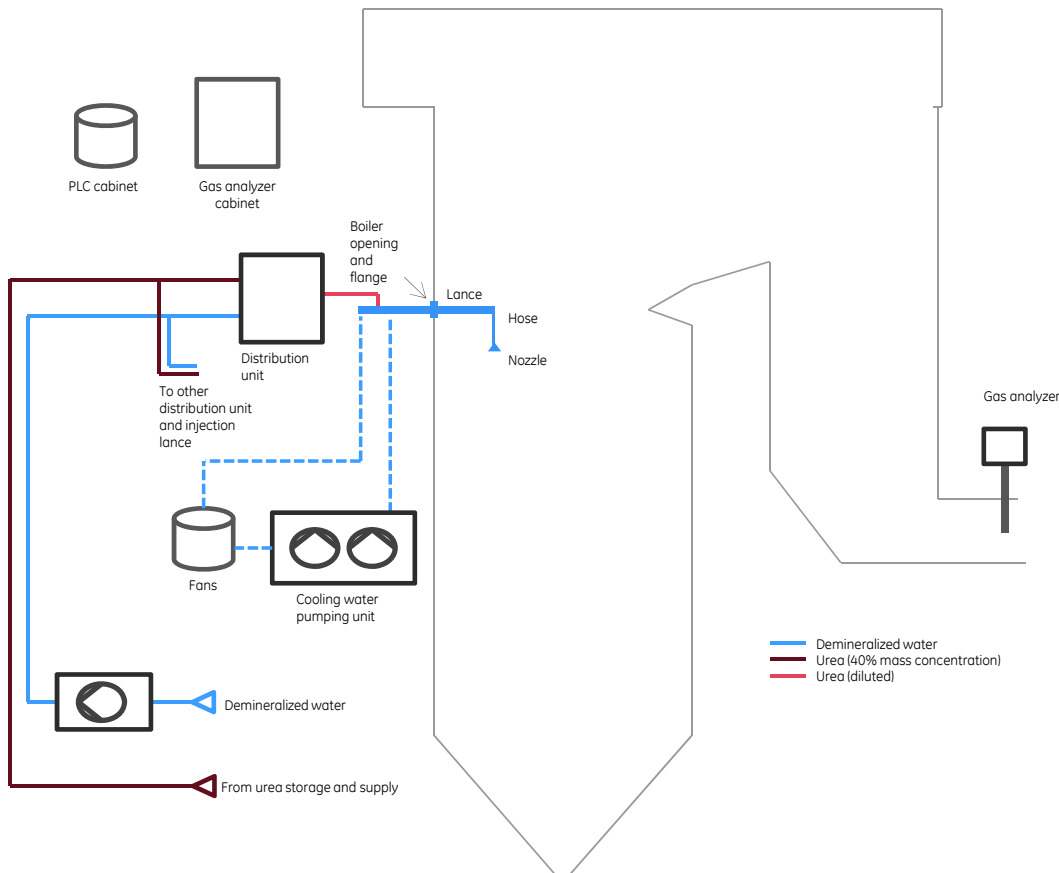


Gerhard Heinz/GE 2017 04 06

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

© 2016 General Electric Company - All rights reserved

Umbrella SNCR system overview



The Umbrella SNCR lances can actively adjust injection height to help the droplets find the correct reaction conditions



Gerhard Heinz/ GE 2017 04 06

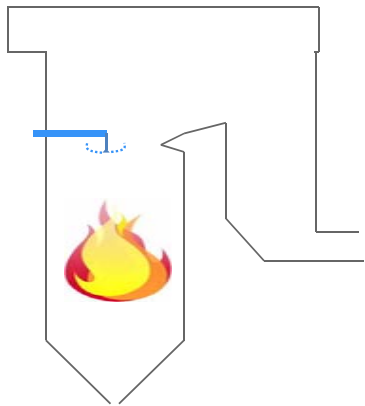
GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

© 2016 General Electric Company - All rights reserved

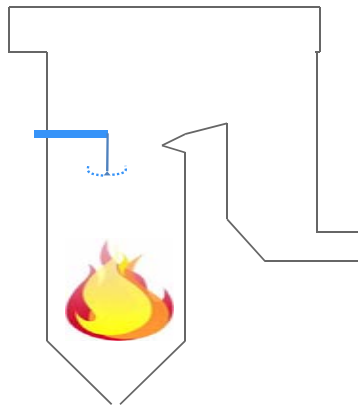
Adjusting for load variations using Umbrella SNCR lances

The injection height of the Umbrella SNCR injection lances is automatically adjusted by simple closed loop PID controls to help the droplets find the correct conditions.

USCNR
nominal Load



USCNR
low Load



- Small number of injection points. Minor pressure parts works, very short outage
- No compressed air needed
- Low water consumption
- Injection from the center of the furnace to maximize coverage of the flue gas stream
- Adjustable injection locations to follow load and other combustion process variations
- USCNR Control using emissions values only. No need for real time furnace temperature mapping devices



U-SNCR Equipment Components

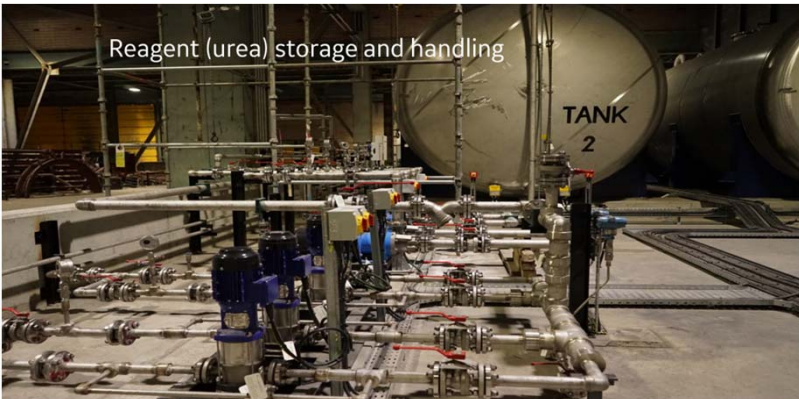
Lance assembly



Boiler opening



Reagent (urea) storage and handling



Urea Storage Tank



Gerhard Heinz/GE 2017 04 06

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

© 2016 General Electric Company - All rights reserved

Corrosion Protection AmStar®



What makes the difference and the benefit?



AmStar[®] to protect Boiler Water Walls

- **CORROSION/EROSION resistant**
 - ✓ **18x** more **corrosion resistant** like Inconel 625
 - ✓ **5x** more **erosion resistant** like Carbon-Steel
- Layer is **FREE from INTERNAL STRESS** (no peeling)
 - ✓ **SCALABLE** up to 6mm layer thickness
 - ✓ No spalling
- **SELF-SEALING** during operation
- Applicable on worn out carbon steel tubes or even Inconel welding overlay
- **Short application time** in the boiler (3-10 m² per sprayer and shift), parallel operation of several sprayer
- **REPARABLE** even for small defects
- Tube base material is after removing the AmStar[®] layer fully weldable
- To apply Amstar[®] is economical and profitable



References

Type	#Boiler	#Projects
PC Kohle	65	95
CFB	35	99
BLRB*	10	33
WtE	20	34
Total	130	261

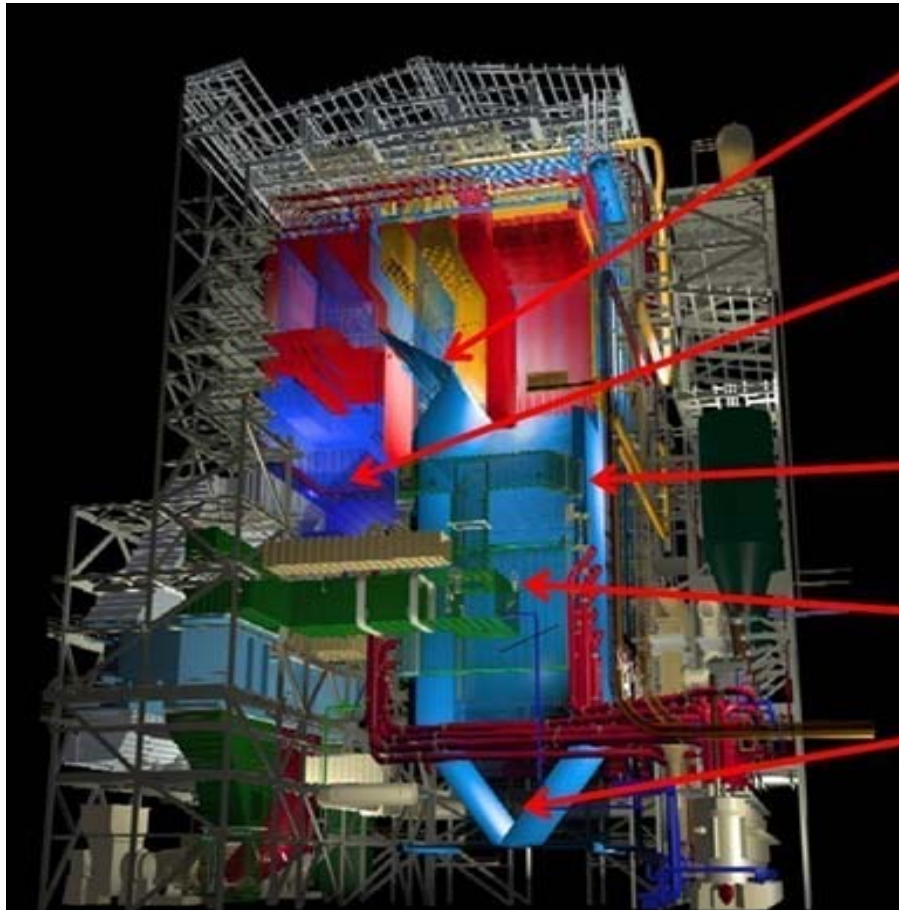
* .. Black Liquor Boiler



Gerhard Heinz/ GE 2017 04 06

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

Where Amstar 888[®] applied



AmStar[®] **Upper slope tube** cladding mitigating sliding abrasion and soot blower erosion

AmStar[®] **Economizer tube** cladding (soot blower and fly ash erosion as shop application)

AmStar[®] **Waterwall** cladding for erosion-corrosion wastage mitigation around wall blowers

AmStar[®] **Waterwall** cladding for fireside corrosion protection

AmStar[®] **Lower slope tube** cladding for erosion and corrosion resistance



Application on boiler roof



Cladding in WtE Plants



Layer control

GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE



Gerhard Heinz/GE 2017 04 06

© 2016 General Electric Company - All rights reserved

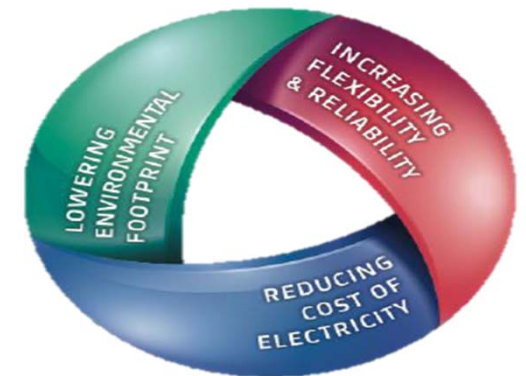
Summary



Summary

GE Power – a global technology solution provider to improve Environmental Footprint by Services & Adaptations & Upgrade Solutions

Our offering contains
to adapt existing Plants
to the changed market conditions



ECONOMIC Optimization

- CAPEX
- OPEX
- MIN outage

- Smart Solutions to Comply with IED
→ Combine increased reliability with flexible operation
- Increase Availability
→ Improve Merit Order and operational benefit

... and discover more about our **BOILER & ECS Technology**



GE Proprietary Information -The information contained in this document is General Electric Company (GE) proprietary information. It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE

