

Keppel Seghers

- Keppel Corp
- Keppel Seghers Thermal Division

Water-Cooled Grate

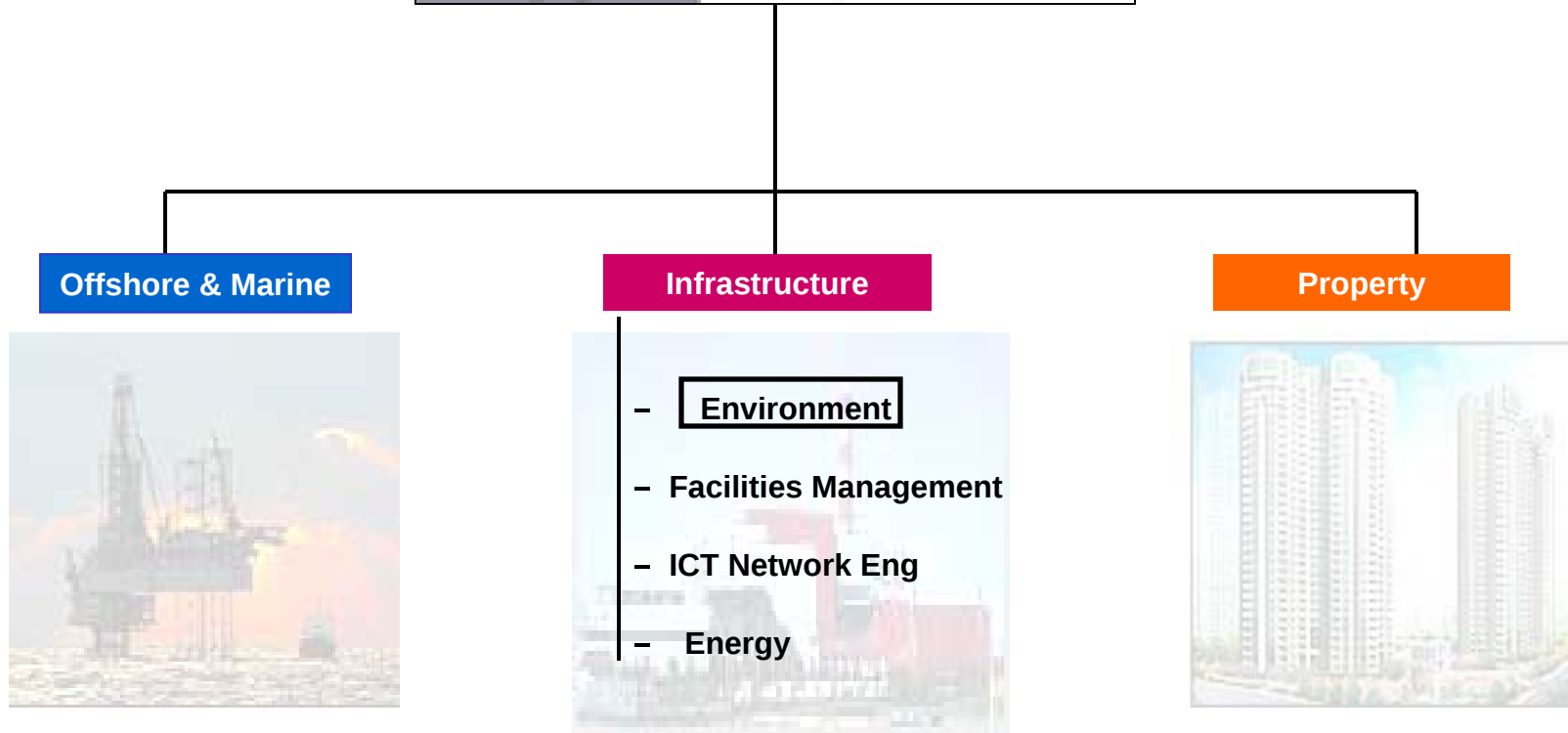
- principles
- cases: Modena (Italy) + Amsdorf (Germany)

Boiler Prism

- principles
- cases: AZN (the Netherlands) + Modena (Italy)



Keppel Corporation



- ➡
- Global foot-print in 25 countries and 20,000 employees
 - Revenue of US\$ 4 billion and profitable
 - Commitment to high level of corporate governance



Keppel Seghers

Offshore & Marine



Shipyard in Brownsville, Texas



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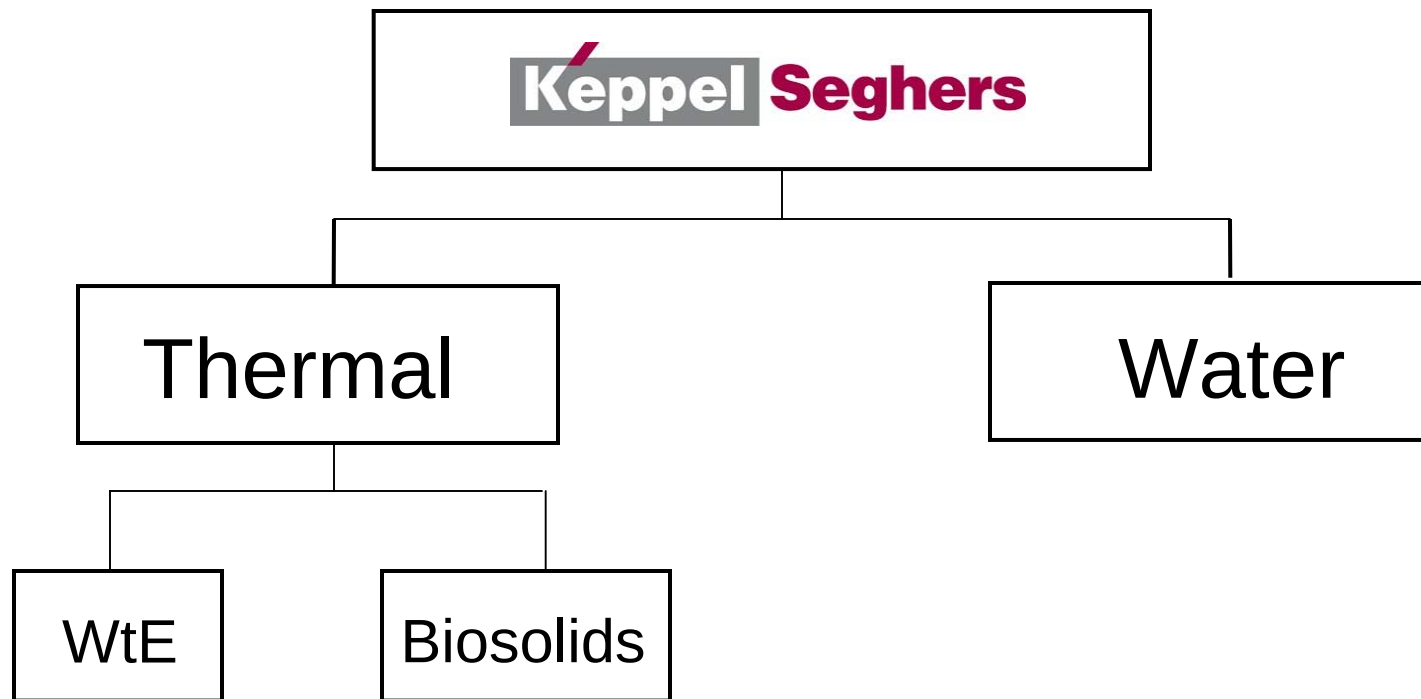
Environmental Technology



Atlanta, Georgia



Keppel Seghers



Biosolids Drying & Pelletizing



Baltimore, MD



Keppel Seghers

Fluidized bed combustion



Spokane, WA



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WtE References

- Antwerp ISVAG Belgium 2x288 ton/day MSW
- Mannheim Germany 1x600 ton/day MSW
- Ohtsuki Japan 2x54 ton/day MSW
- NanShan Shenzhen China 2x400 ton/day MSW
- Orebro Sweden 1x200 ton/day Industrial Waste
- Bao An Shenzhen China 3x400 ton/day MSW
- Collefero Italy 4x278 ton/day RDF
- Modena Italy 1x540 ton/day MSW
- Suzhou China 3x350 ton/day MSW
- Changshu China 2x330 ton/day MSW



- Antwerp INDAVER Belgium 1x533 ton/day Industrial + MSW
- Kwan-Ju Korea 2x200 ton/day MSW
- Ui-JeongBu Korea 2x100 ton/day MSW
- Asslar Germany 2x44 ton/day MSW
- Antwerp INDAVER Belgium 2x319 ton/day Industrial + MSW
- Ghent IVAGO Belgium 2x139 ton/day MSW
- MokDong Seoul Korea 2x200 ton/day MSW
- Kempten Germany 1x194 ton/day Biomass
- Amsdorf Germany 1x186 ton/day RDF



WtE References

Location: Shenzhen, China

Capacity: 5 x 400 TPD

Start-up: 2004



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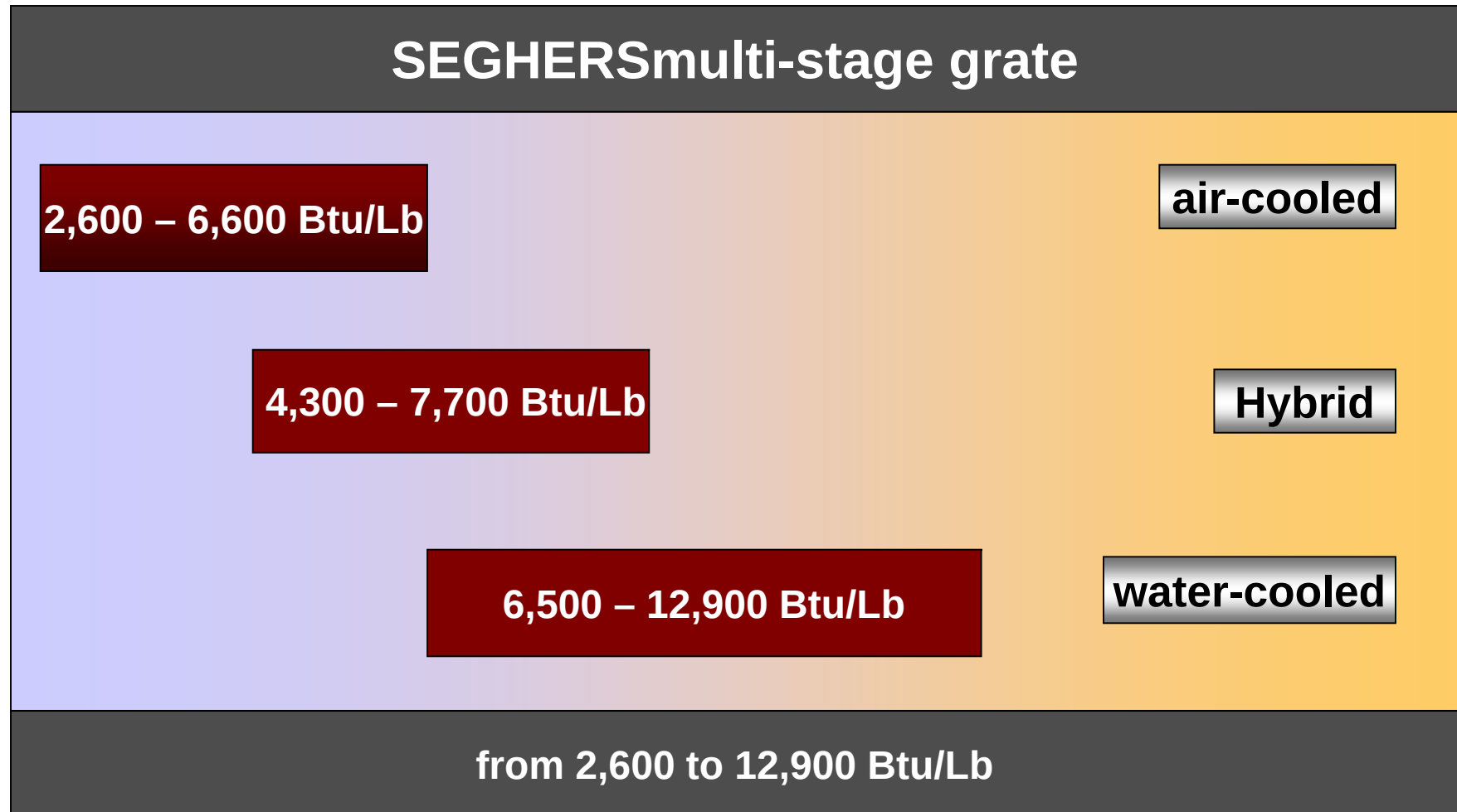
- principles
- Examples: Modena, Italy + Amsdorf, Germany

Boiler Prism

- principles
- cases: AZN (the Netherlands) + Modena (Italy)



Grate Type as function of Heating value



Main Characteristics

- Absorbed power $\approx 3\%$ total thermal load
- Cooling water
 - temperature inlet 60 - 80 °C
 - temperature outlet 90 - 110 °C
 - pressure inlet 3 - 8 bar
- Long lifetime $> 32,000$ h
- Primary air for incineration only, not for grate cooling
- Closed cooling water circuit
- Long elements with few connections
- Negligible grate siftings ($< 1\%$)
- Can be retrofitted on any grate type



Recent projects

Location: Modena, Italy

Capacity: 1 x 717 TPD

Heating values (HHV):

average: 6000 BTU/Lb

high : 8040 BTU/Lb

Horizontal Boiler (390°C, 50 bar)

Start-up: 2006



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Recent projects

Location: Amsdorf, Germany

Owner: Romonta GmbH

Capacity: 1 x 205 TPD

Heating value (HHV):
average: 6150 BTU/Lb
high : 7100 BTU/Lb

Horizontal Boiler (400°C, 40 bar)

Start-up: 2004
first year availability: 92.2%



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References

WtE Watercooled Grate Plants Reference List

Place	Client	Waste type	Grate type	Calorific Value (kJ/kg)g	No. of Lines	Capacity (tonnes/day) per Line	Thermal Power (MWth)	Start-up
Modena (Italy)	Meta	RDF	Watercooled	12.550	1	648	78	2006
Amsdorf (Germany)	Romonta GmbH	RDF	Watercooled	13.000	1	186	28	2004
Örebro (Sweden)	SAKAB Sydkraft	Industrial Waste	Watercooled / Aircooled	11.800	1	300	41	2003
Colleferro II (Italy)	Lurgi	RDF	Watercooled	15.000	1	278	57,4	2003
Colleferro I (Italy)	Lurgi	RDF	Watercooled	15.000	1	278	57,4	2002
Terni (Italy)	Lurgi	RDF	Watercooled	15.000	1	278	57,4	2002
San Vittore (Italy)	Lurgi	RDF	Watercooled	15.000	1	278	57,4	2001

⇒ total number of operating hours: + 120,000

100% availability of all WC grates



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Water-Cooled Grate

principles

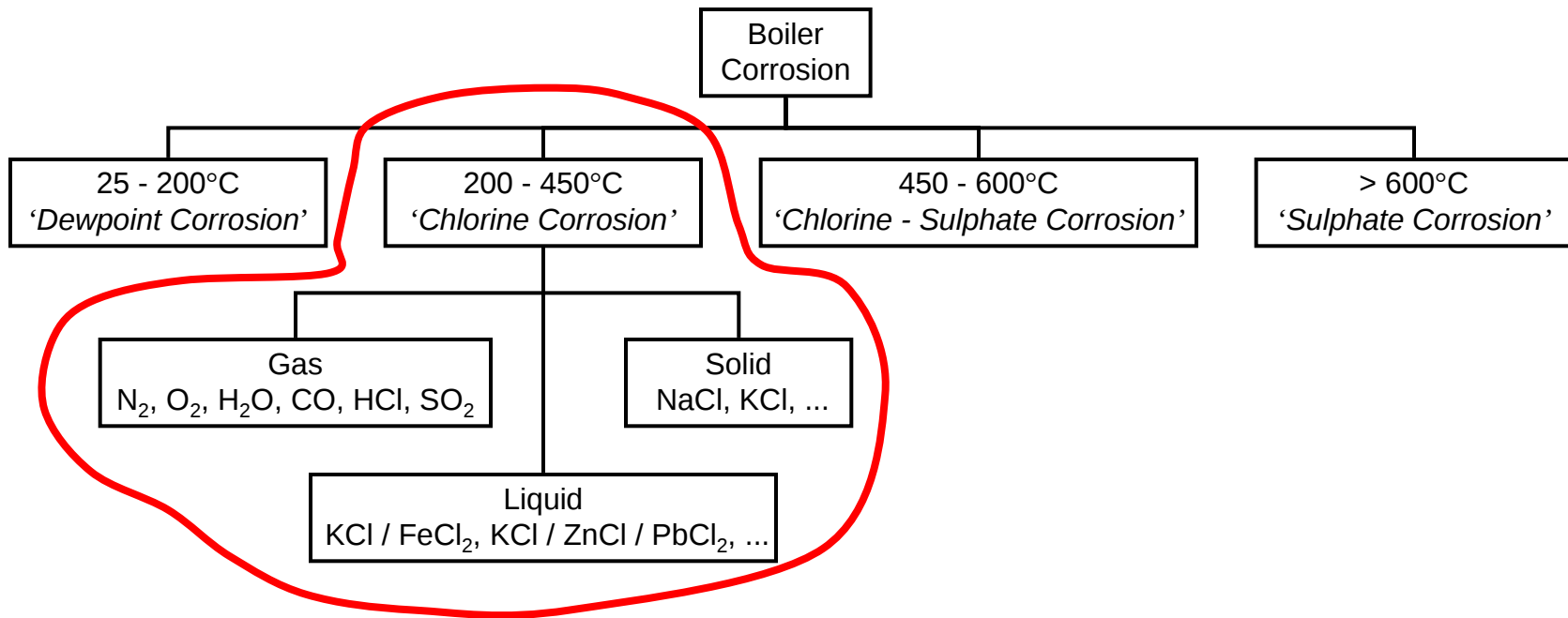
cases: Modena (Italy) + Amsdorf (Germany)

Boiler Prism

- principles
- cases: AZN (the Netherlands) + Modena (Italy)



HT Corrosion: Definition



HT Corrosion

- . $200^{\circ}\text{C} < T_{\text{metal}} < 450^{\circ}\text{C}$
(max. $550^{\circ}\text{C} \rightarrow$ sulphate corrosion gains importance)
- . primarily chlorine corrosion
- . relevant during normal operation



HT Corrosion: General Guidelines

Less corrosion if:

1. early sulphatisation is promoted

(low T_{FG} , good mixing, sufficient oxygen & S available)

2. impact velocity & FG recirculation zones are minimised / avoided

(uniform flow pattern & well behaved transition 1st - 2nd pass)

3. hot spots are avoided

(good mixing, stable process, homogeneous waste mix)

4. volatilisation of salts is limited

(low $T_{furnace}$; seek reasonable burnout; operate a 'soft' fire)

5. chlorine contents of the waste is limited

(max. allowable Cl-contents ~ S, Na, K, Pb, Zn, Si ; Cl/S-ratio!)

6. flue gases & fly ash are burnt out completely

(avoid local lack of O_2 & local production of heat)



Top view SEGHERS Boiler Prism



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Seghers Boiler Prism



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View on Prism after 9,000 h operation



References

WtE Prism Plants Reference List

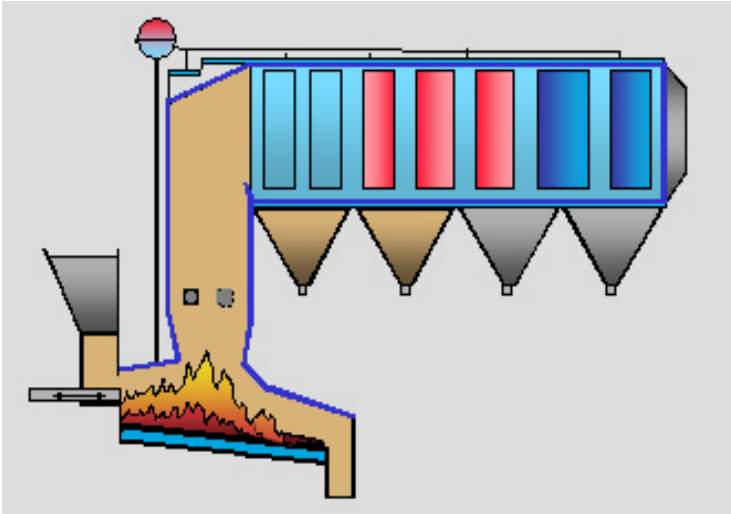
Location	Client	Waste type	Grate type ⁽¹⁾	Calorific Value (kJ/kg)	No. of Lines	Capacity (tonnes/day) per Line	Thermal Power (MWth)	new / retrofit	Steam Parameters (°C / barg)	Start-up
Modena (Italy)	Meta	RDF	WC	12.550	1	648	78	new	390 / 50	2006
Mannheim (Germany)	MVV	MSW	AC	9.600	1	600	67	new	268 / 47	2003
Moerdijk (Holland)	AZN	MSW	WC	11.000	3	636	81	retrofit	400 / 100	2003 2001
Bonn (Germany)	MVA Bonn	RDF	AC	10.100	3	250	29	retrofit	400 / 40	1999 1998 1997

⁽¹⁾ : AC : Air Cooled / WC: Water-Cooled

⇒ combined operating experience: + 25 years



Case 1: AZN (the Netherlands)



Technical Data

- 3 x 700 TPD @ 5200 BTU/Lb
- steam at 1,450psi, 750 F
- start-up in 1997

Problems

- high flue gas temperature at inlet 2nd pass (1740 F)
- severe corrosion (roof, EVA, SH), lifetimes:
 - eva screen < 2 yrs
 - final SH < 3,5 yrs
 - frequent unplanned shut-downs
- high maintenance & repair costs
- excessive slagging (grate + SA-zone)
- availability < 7,500 hrs

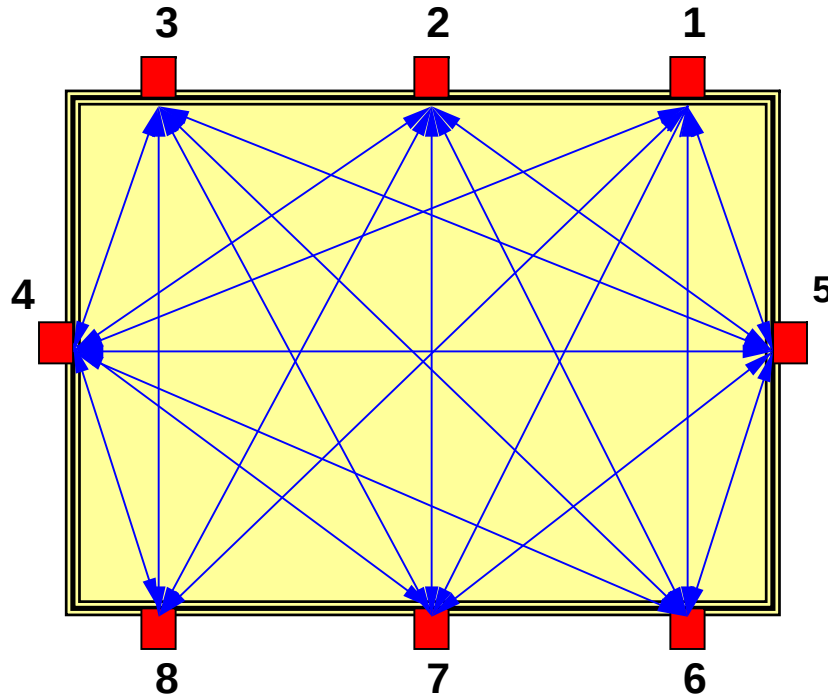


Retrofit of AVI AZN-Moerdijk, Holland

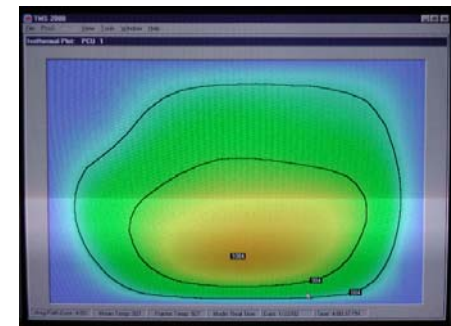
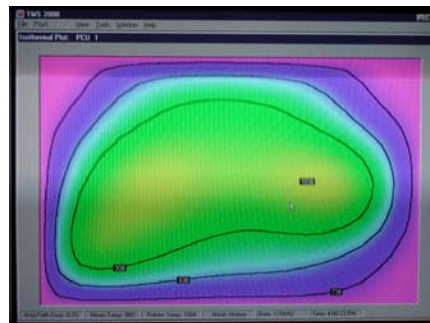
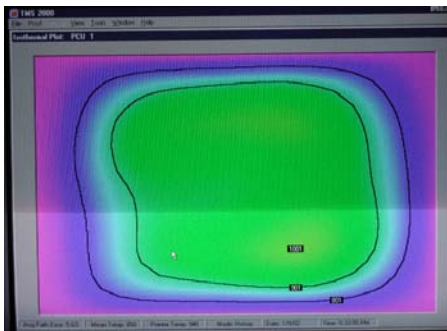


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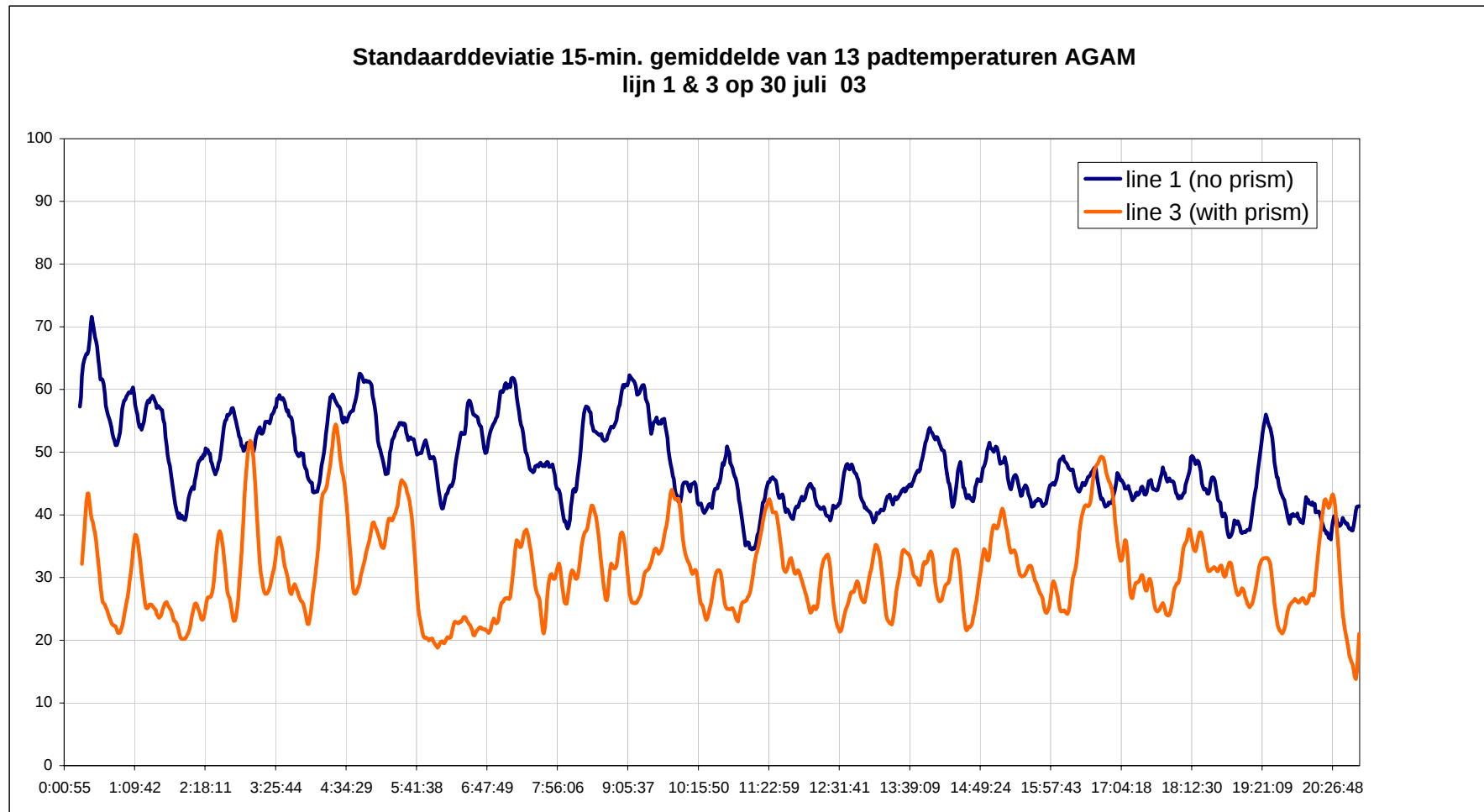
Case 1: AZN: Performance Validation 1



- 8 acoustic transceivers (AGAM)
- 5,2 m above SEGHERSprism
- implemented on all 3 lines
- 22 paths $\Rightarrow$ 22 avg. temperatures
- cycle time: 60 - 70 sec.
- on-line 2D picture (CR)
- www.budi.de/produkte/agam



Case 1: AZN: Performance Validation 1: Results



Case 1: AZN: Performance Validation 1: Results

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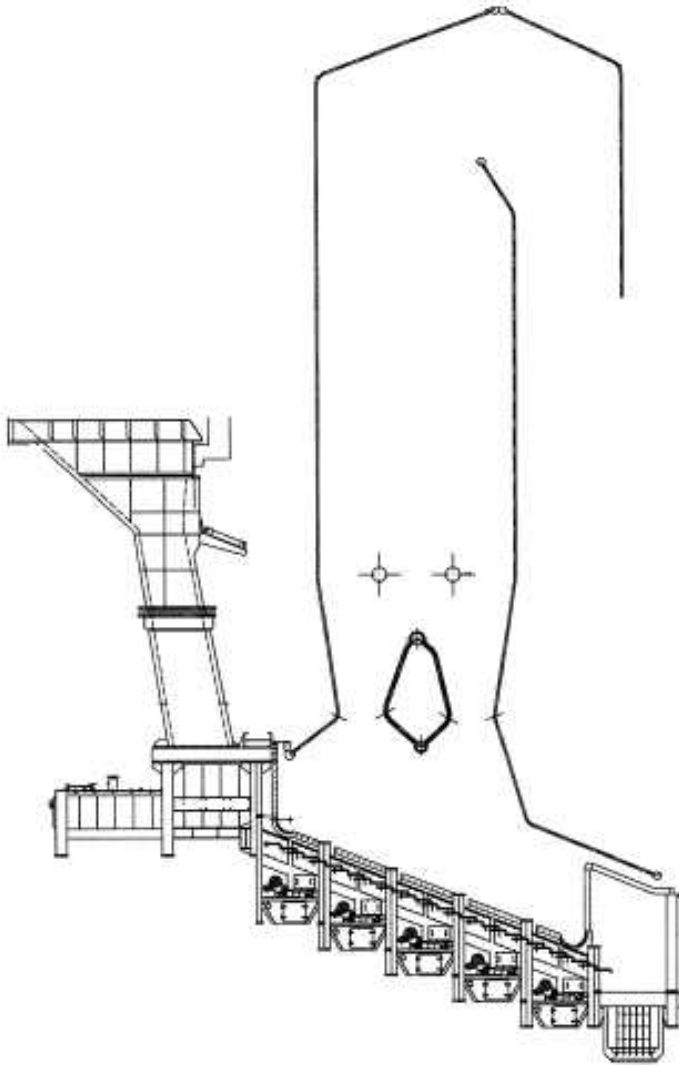


Case 1: AZN: Conclusions

- Corrosion rate measurements over 2 years indicate a decrease in wall thickness loss by a factor 5 - 10.
 - The following additional benefits were observed:
 - 8% increase in throughput
 - 50% increase in 'reisezeit'
 - 6% increase in availability
 - 14% decrease in maintenance costs
 - 54% decrease in natural gas consumption
 - 29% decrease in ammonia consumption
- ⇒ **Pay Back Time of 3,1 yrs**



Case 2: Modena (Italy)



Presentation Overview

Keppel Seghers

- Keppel Corp
- Keppel Integrated Engineering
- Keppel Seghers Technology Portfolio
- Keppel Seghers Thermal Division

Water-Cooled Grate

- principles
- case studies: Modena (Italy) + Amsdorf (Germany)

Boiler Prism

- principles
- case studies: AZN (the Netherlands) + Modena (Italy)

R&D Focus



R&D Focus for WtE

- increased energy efficiency (electrical, CHP)
- reduction of boiler side corrosion
- optimised combustion concept
(reduction pollutant load through primary measures)
- improve cost-effectiveness of flue gas cleaning components
- integrated flue gas cleaning components
- increase residue quality & re-use potential (ash & APC residues)
- novel applications for FB systems



