Boiler Technology by Steinmüller Babcock Environment

Värme- och Kraftkonferensen 2014

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Steinmüller Babcock Environment
SBEnG
NIPPON STEEL & SUMIKIN ENGINEERING GROUP

Agenda

- **Introduction of SBEng**
- **Aspects concerning the design of EfW boilers**
- **Examples of large scale EfW plants**
- **Linköping boiler concept**
- **Tekniska Verken Project: Lejonpannan in Linköping**

Roots of the Company

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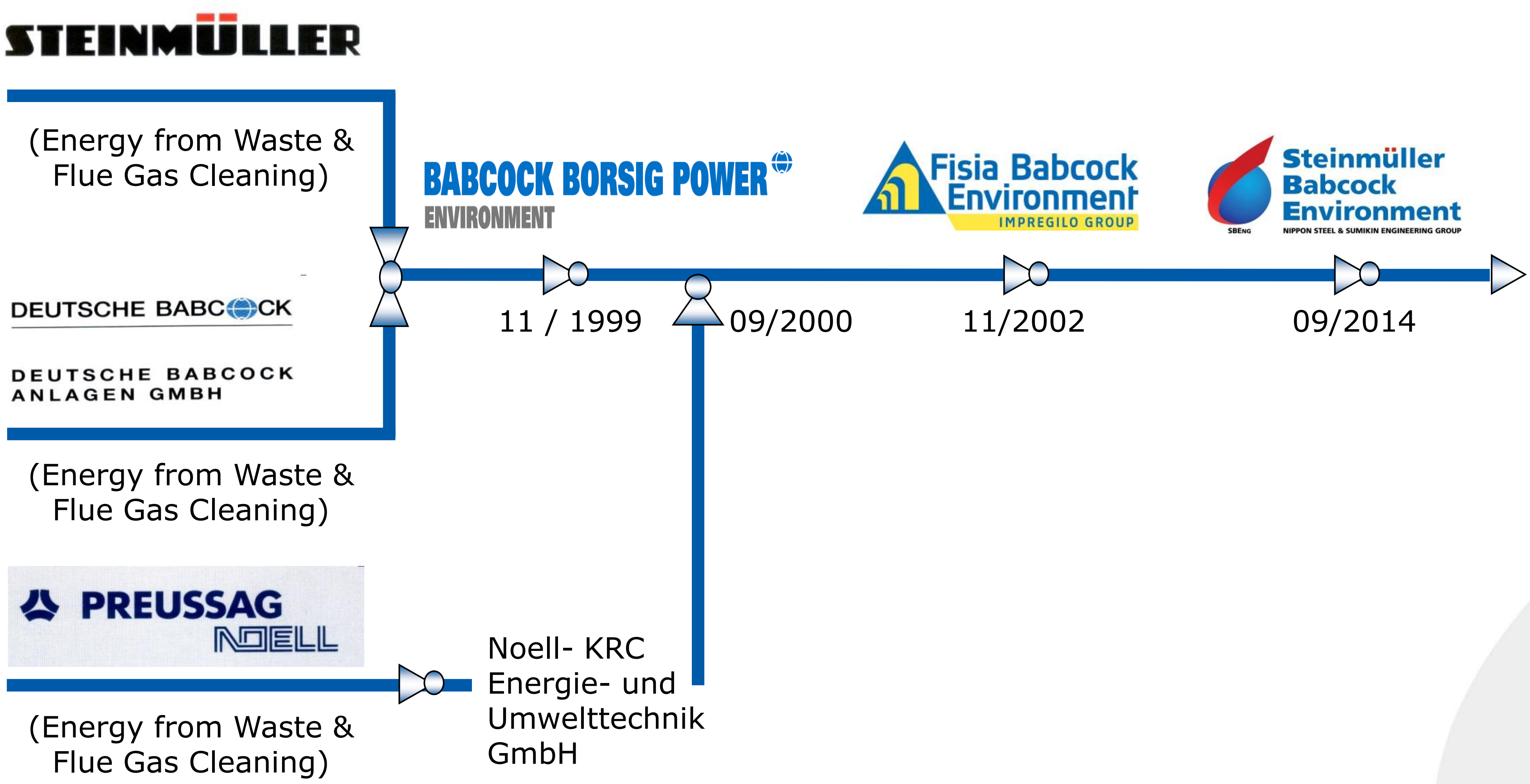

Ownership Structure

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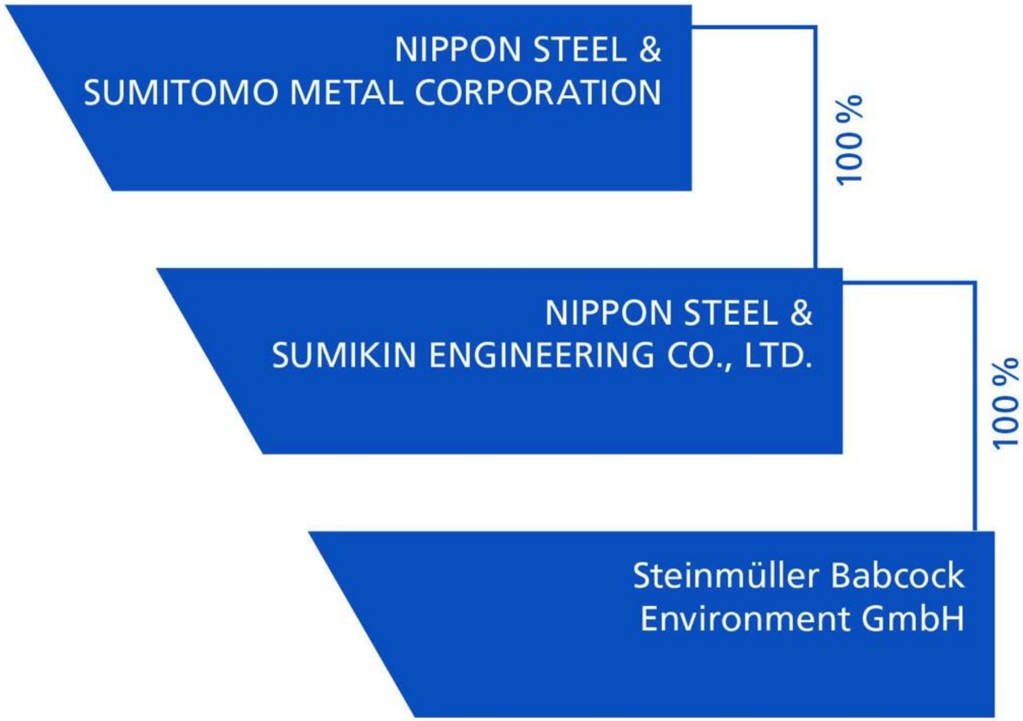


NSENGI - Business Field "Environmental Solutions"

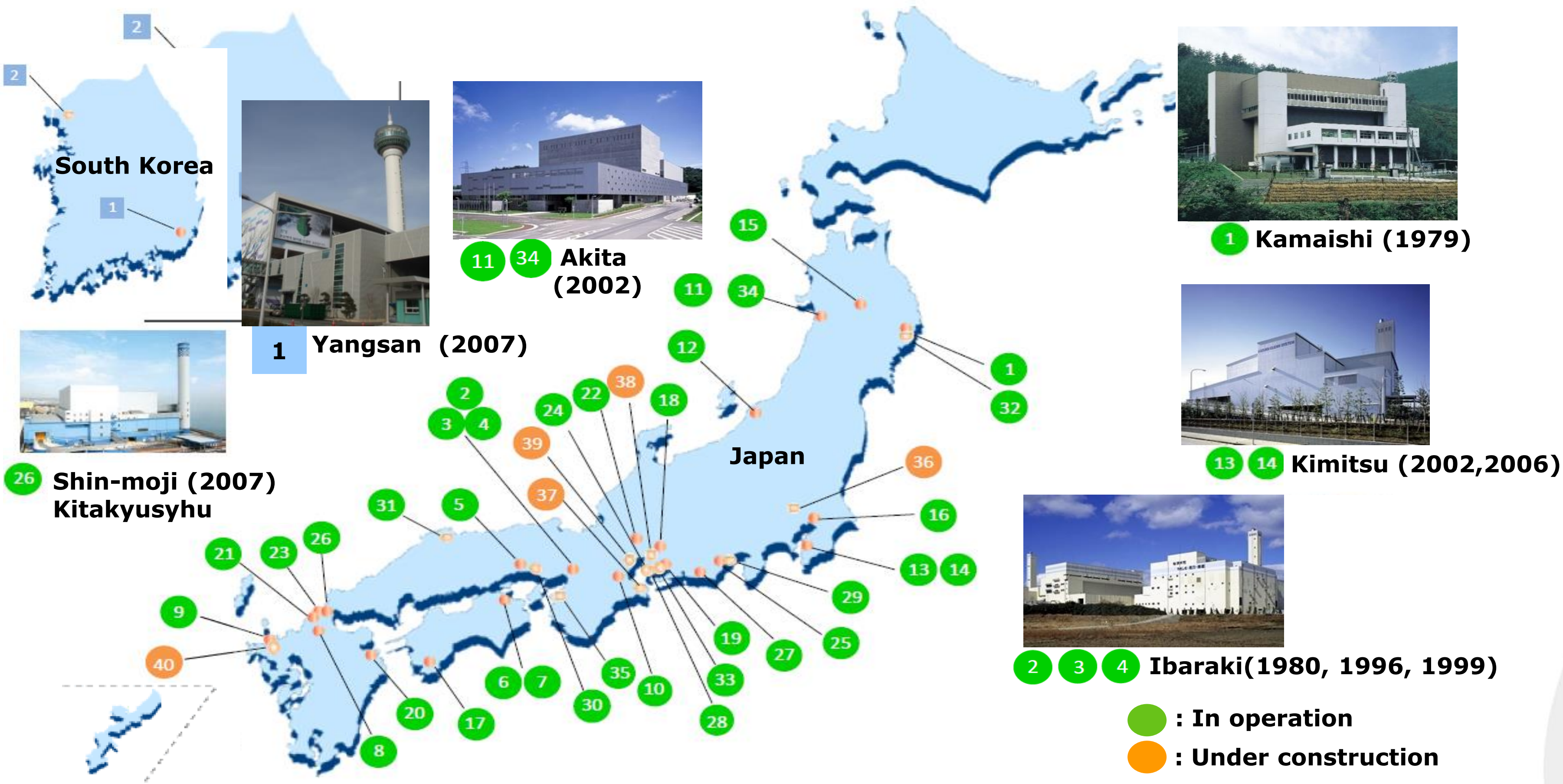
- **Waste Gasification and Melting Technology/ (Direct Melting System, DMS)**
- **Gasification Recycling Facility for Waste Tyre**
- **Biomass Gasification**
- **Biomass to Ethanol Technology**
- **Processing harmful and difficult-to-treat materials**
- **Soil remediation**
- **Groundwater cleaning**

Direct Melting System

Gasification Recycling Facility for Waste Tyre

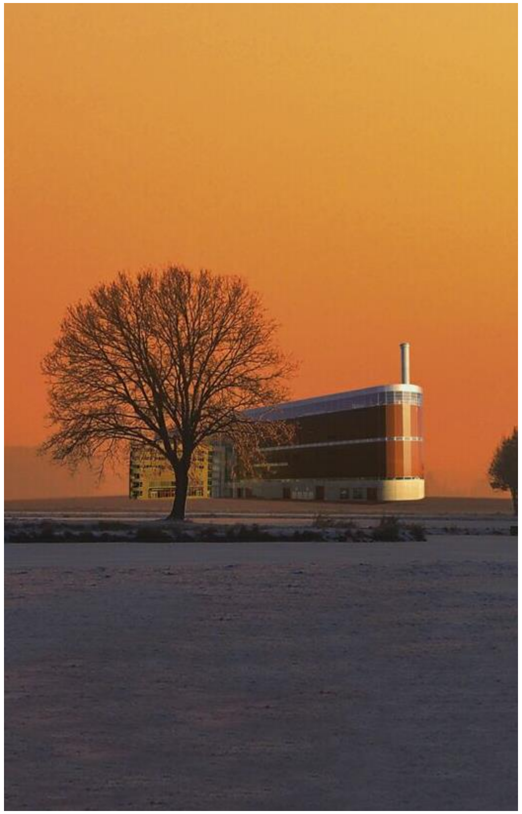
NSENGI – Reference list of DMS in Japan and South Korea

- **Number of records: 42 references** (World's highest number)
- **Facility size: 100,000 ~ 230,000 t/annual** (World's largest capacity)
- **Term of operation: 34 years** (World's longest term)

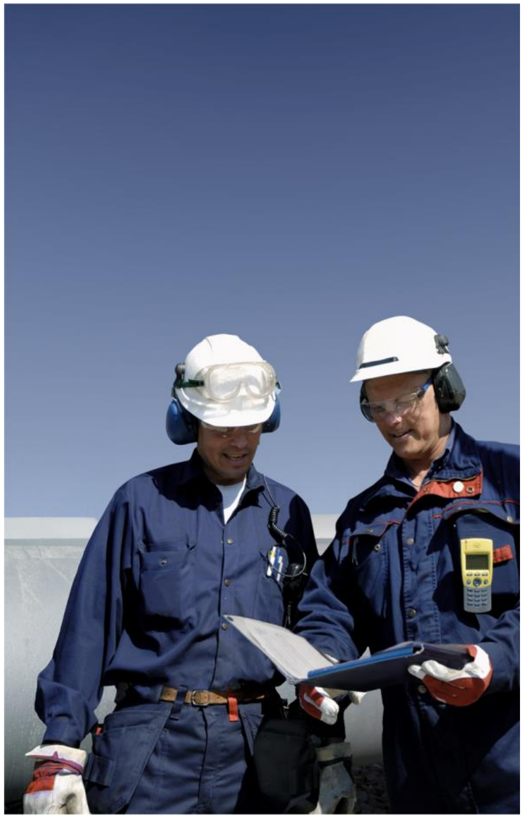


Product Divisions of SBEng

Flue Gas Cleaning



Energy from Waste



After Sales Service

SBEng´s Core Competences and Strengths

- **Own developed and proven grate technologies**
- **Long-time engineering expertise in boiler design**
- **FGC concepts tailored to client´s requirements**
- **Design of core components by own specialists**
- **Balance of plant design**
- **Integrated management system for quality, health, safety and environment**
- **Contract execution as general contractor**
- **Our after sales experts support our clients after takeover**

EfW Plants built by SBEng in Sweden

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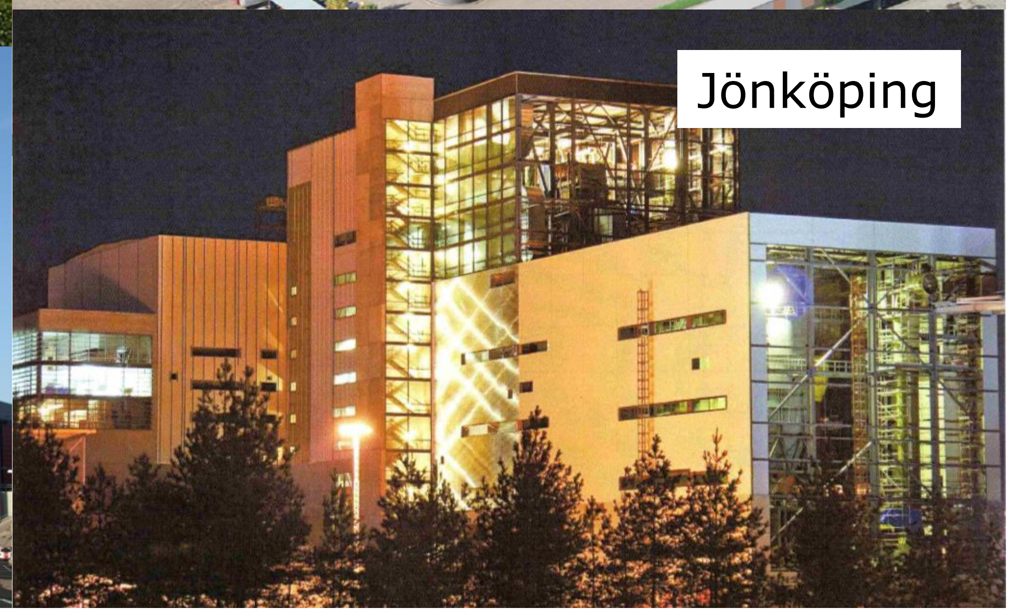

After Sales Service

- Spare Parts Management
- Plant inspections/ revisions
- Repairs
- Engineering provider
- Refurbishment/Uprating
- Service contracts

After Sales Service Capabilities

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Aspects concerning the Design of EfW Boilers

Process design aspects, such as

- Steam parameters
- Excess air ratio
- Flue gas outlet temperature

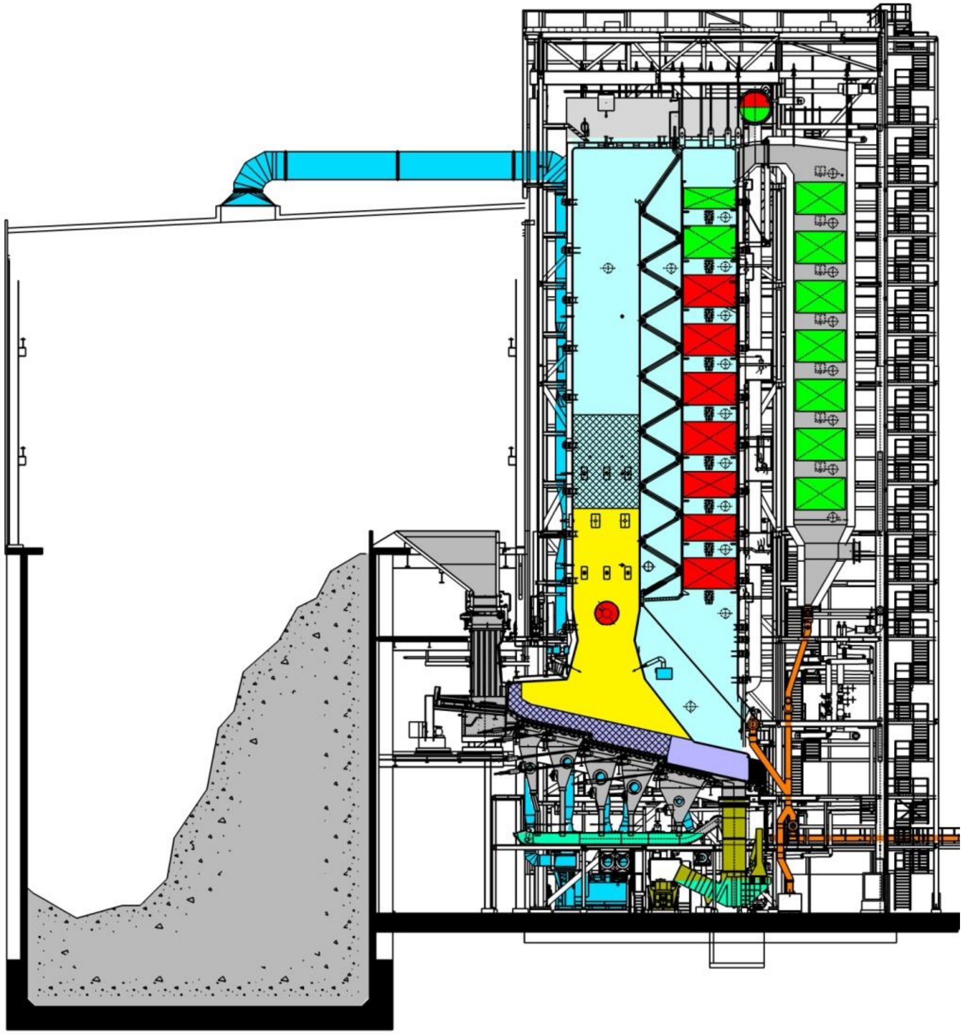
mainly define the efficiency of the boiler plant.

Mechanical design aspects, such as

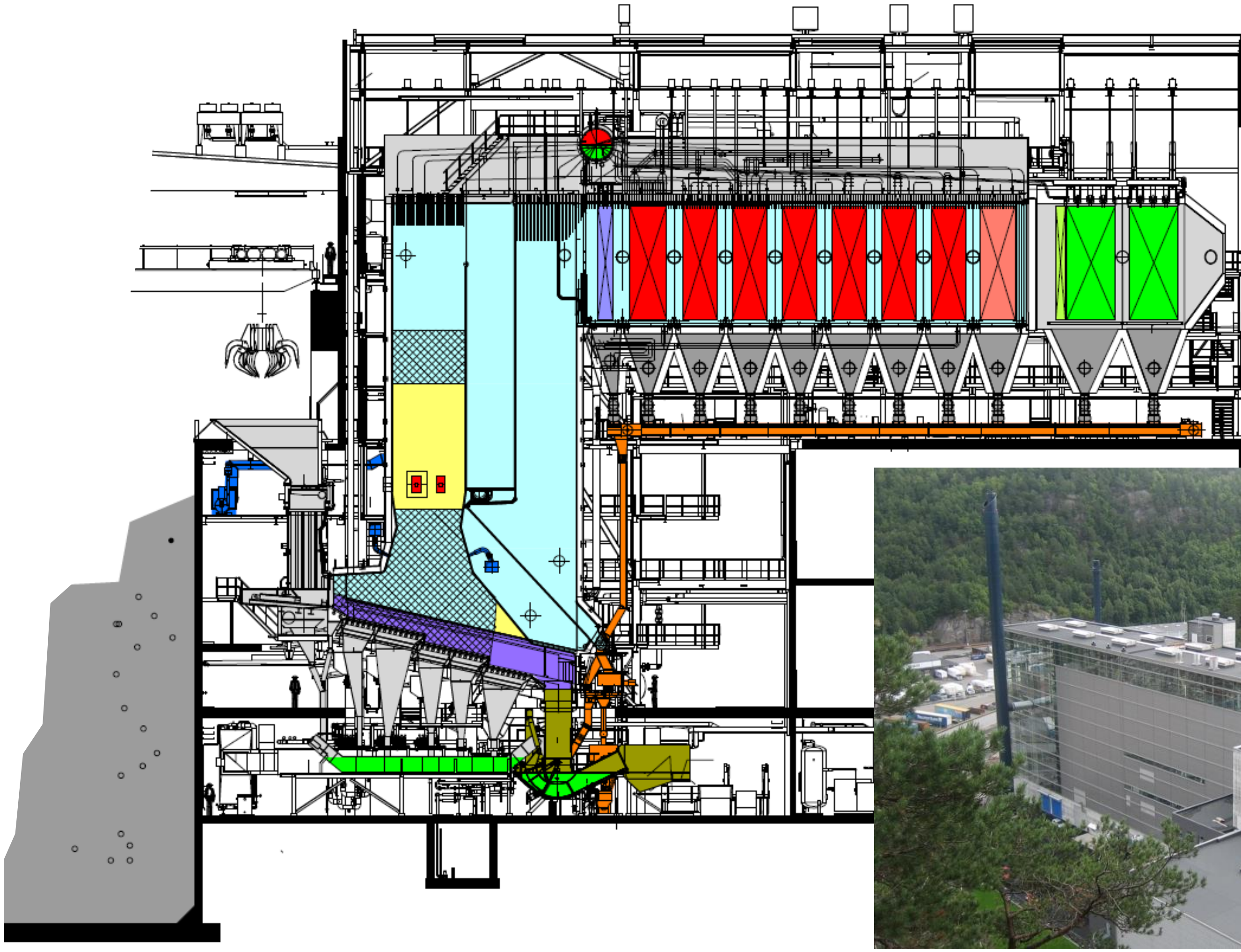
- Vertically or horizontally arranged convective heating surfaces
- Bottom or top suspended boiler
- Overall plant size

mainly define the plant layout.

Four Pass Vertical Boiler
Klaipeda/ Lithuania



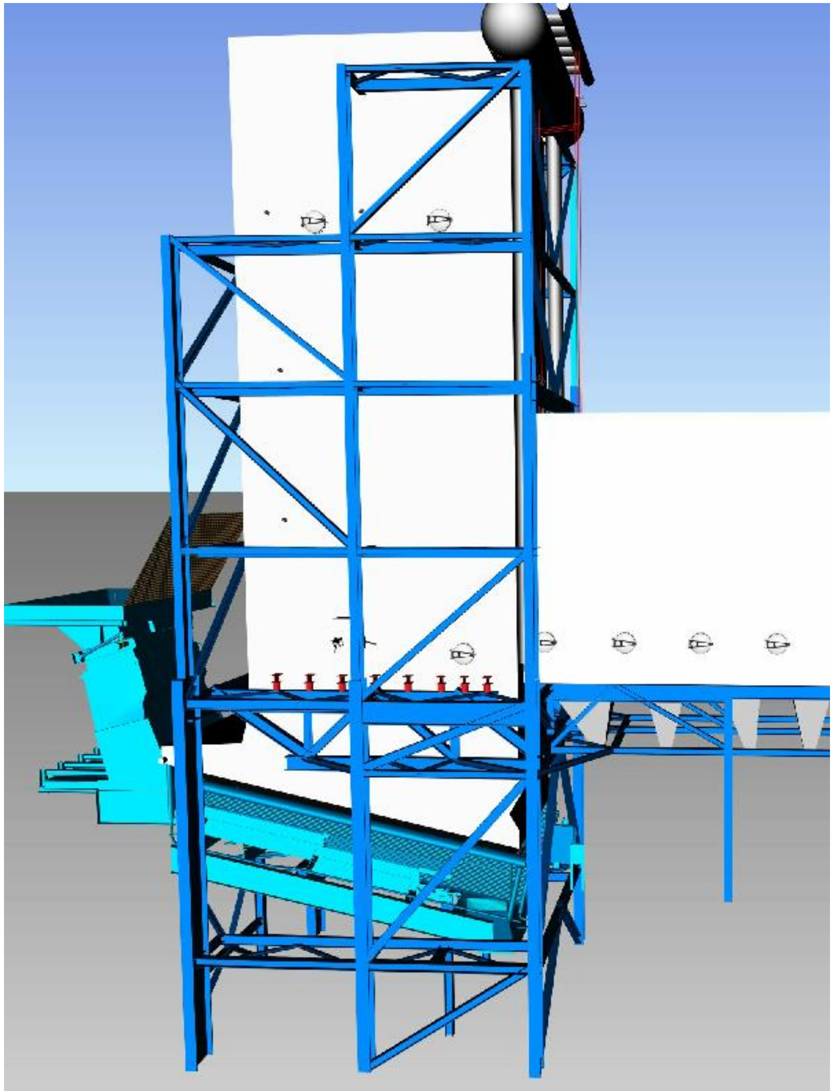
Four Pass Horizontal Boiler Kristiansand/ Norway

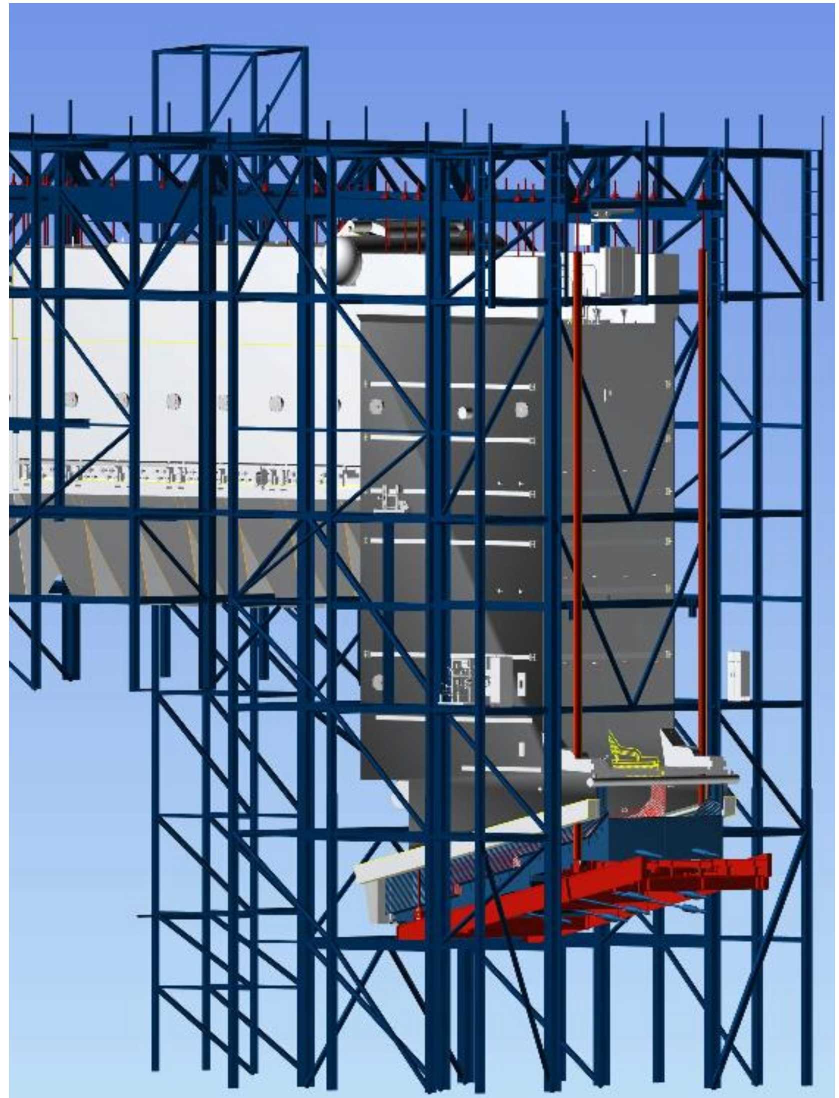


Horizontal versus Vertical convective Pass

	Horizontal	Vertical
Boiler Concept	3 vertical radiation passes, convective heating surfaces in a arranged horizontally in 4th pass.	4 vertical passes. The 1st pass as empty radiation pass, 2nd radiation pass evtl. with platen heating surfaces. Convective heating surfaces in 3rd and 4th vertical passes.
Area required	Approx. 20-30% more of boiler length.	Additional space required for sootblowers in terms of distances between two boilers and overall plant width.
Overall height	3 radiation passes allow for lower boiler height.	The vertical concept increases the height of the building.
Extraction of ash	About 6 or more hoppers + rotary locks or double flaps and a collecting sifting conveyor.	The minor amount of ash is carried over to the FGC system downstream of the boiler.
Heating surface cleaning	Pneumatic rappers with frequent operation. Low energy consumption.	Steam sootblowers with high efficiency. Operation once per shift. Steam consumption slight negative impact on rated power output of turbine/generator.

Bottom supported versus top suspended Grate and Boiler



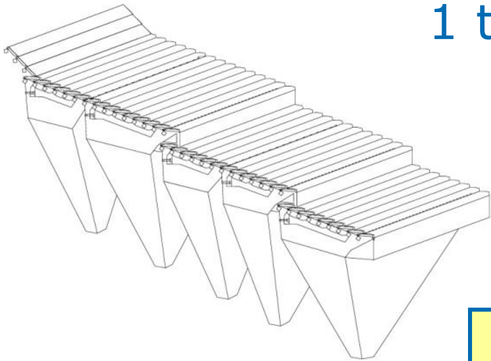


Bottom supported versus top suspended Grate and Boiler

	Bottom Supported	Top Suspended
Steel Structure	Separate steel structure for boiler house required.	Top suspended boiler allows for integrated steel structure for boiler house.
Grate suspension	For small units bottom suspension of grate and boiler is appropriate since there is only little compensation required. Also very large grates can be bottom suspended due to high loads.	Top suspended boiler allows for top suspended grate ->no difference in thermal expansion -> no compensation required. -> Good excess under grate.
Furnace	Adiabatic combustion chambers can be bottom suspended due to high loads of refractory.	**SBEng´s standard layout with top suspension of feeder, grate and boiler for plants from 35 MW up to 110 MW.**
Waste Feeder	Large units rather use standing waste feeder due to high loads of waste in the chute.	

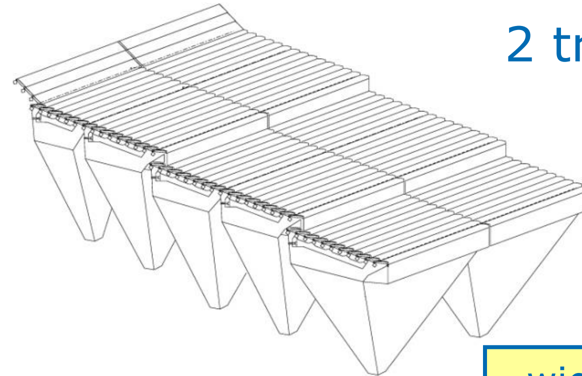
Plant Size – Modular Design of SBEng Grates

1 track



width 3.55 m

2 tracks

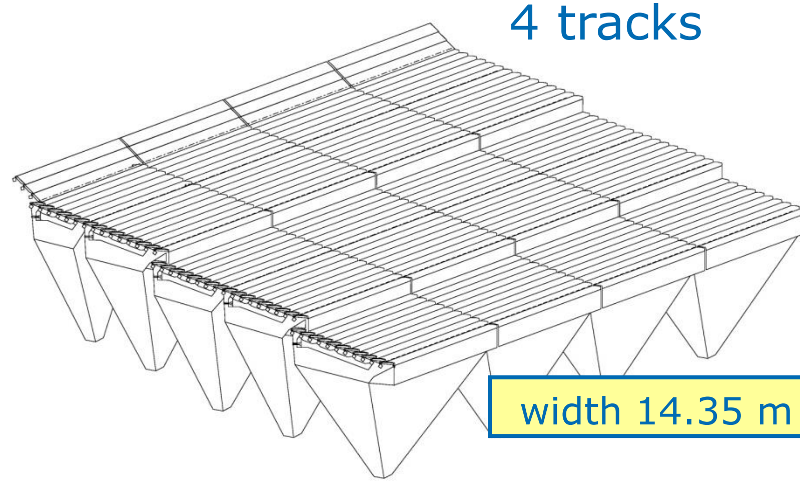


width 7.15 m

3 tracks

width 10.75 m

4 tracks



width 14.35 m

intermediate sizes are also available

4-Track Grate at EfW Plant Berlin Ruhleben

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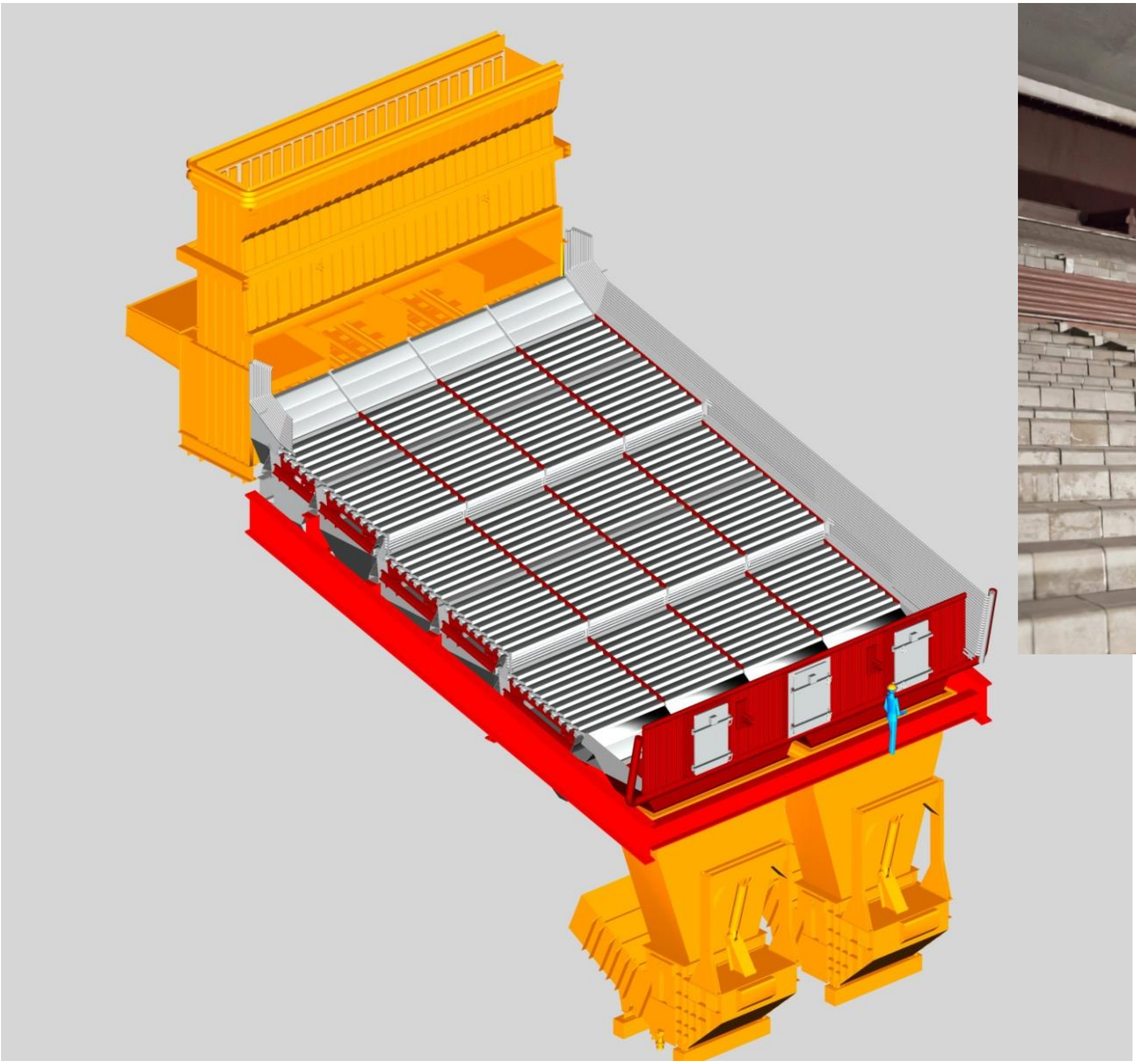

Pros and Cons of large-scale Facilities

Pros:

- Foot print
- Volume of facility
- No. of process and instrument/control equipment related to throughput
- Investment cost
- Combustion conditions without aux. fuel
- Sensitivity against off spec fuel
- Labour cost
- Maintenance cost

Cons:

- Effort for fuel storage during down time of one unit
- Part load capability regarding over all throughput

Grate & Boiler Technology
Range of gross Heat and Throughput

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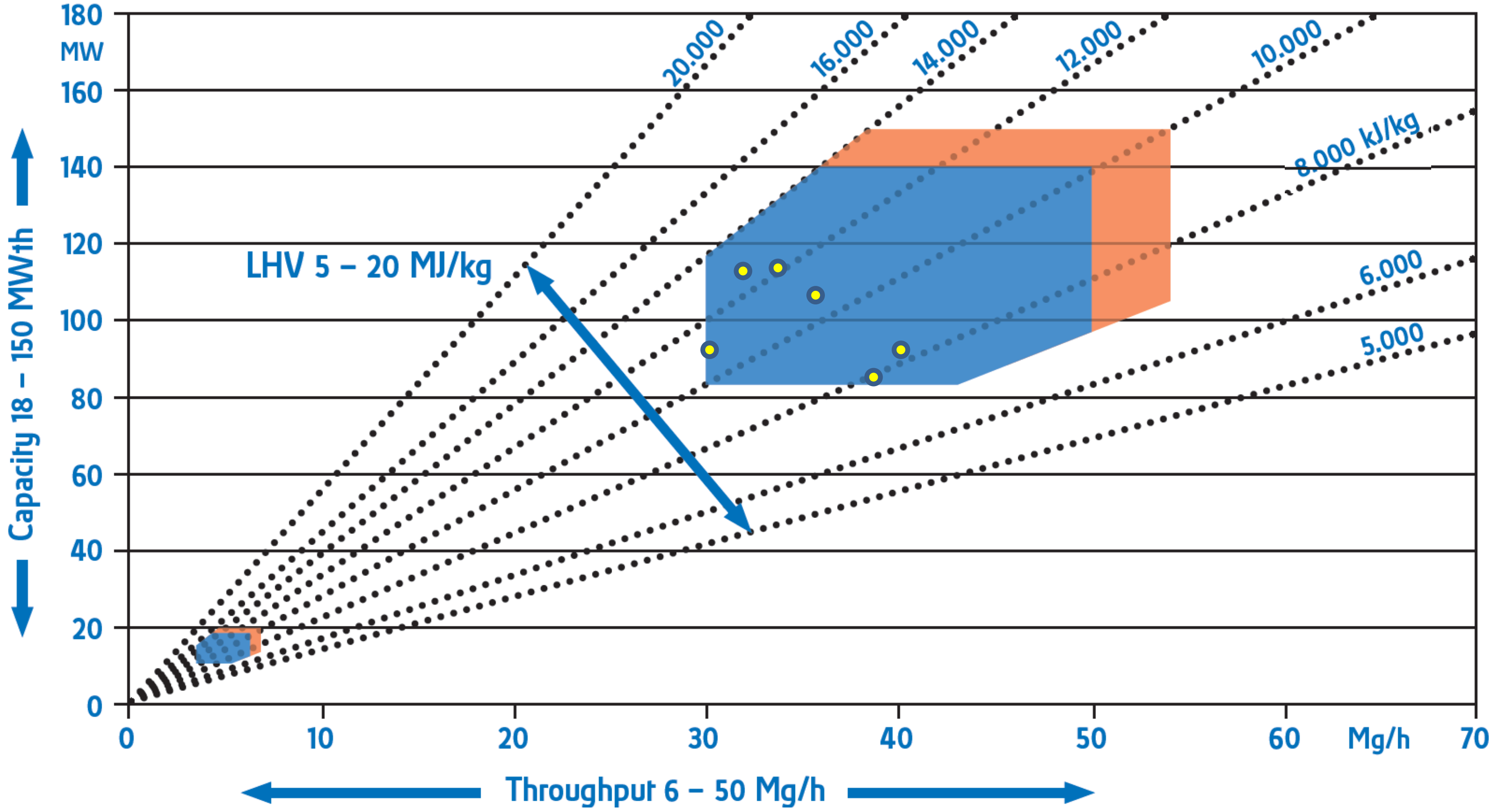

RDF Plant Rüdersdorf/ Germany 1/2

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Location
Rüdersdorf, Germany

Purchaser
Vattenfall Europe
Waste to Energy GmbH

Fuel
Refuse derived fuel

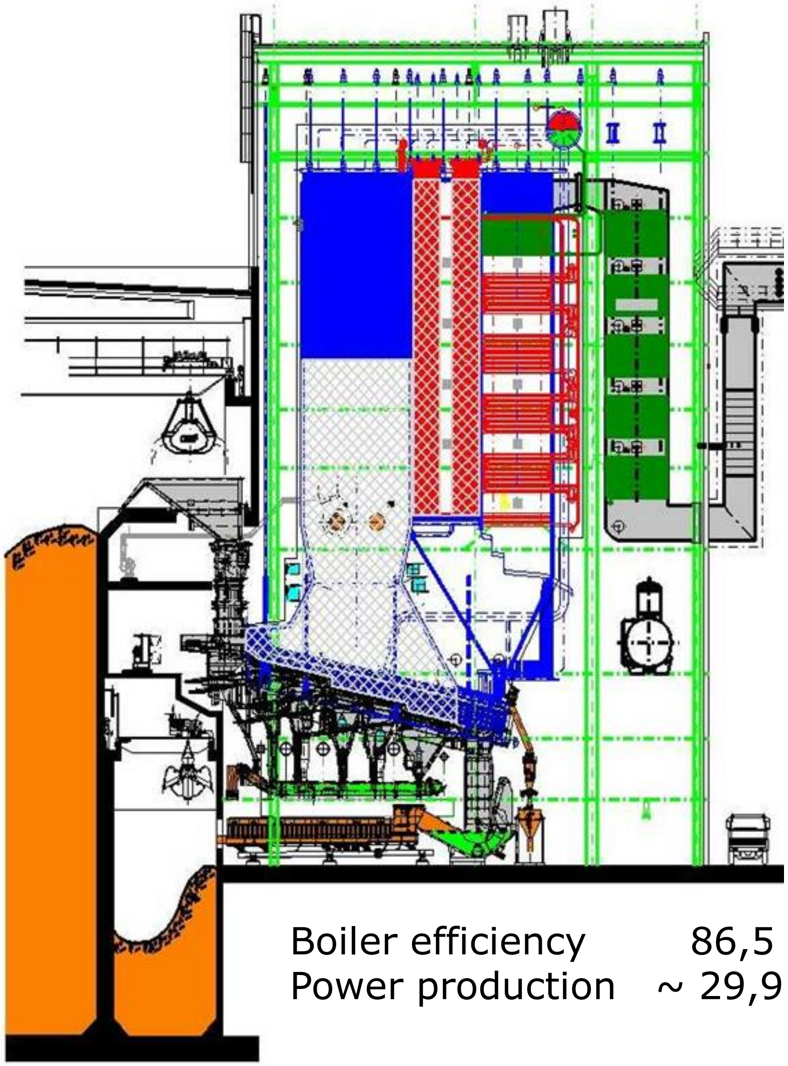
Capacity
114.2 MWth
1 x 32.9 t/h
12 500 kJ/kg

Grate System
Forward moving grate
(water-cooled)

Year of Start Up
2008

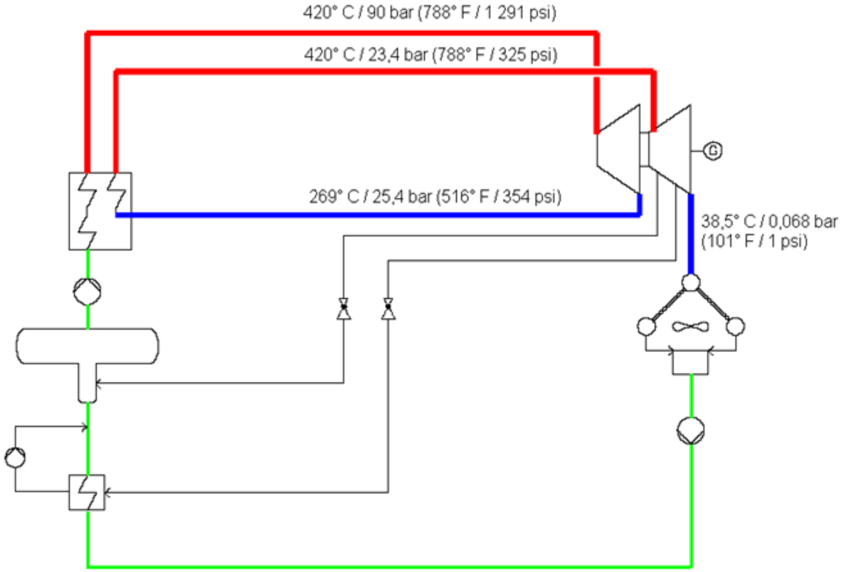
SBENG Scope of Supply
Firing system
Steam generator
Gas cleaning

RDF Plant Rüdersdorf/ Germany 2/2



Boiler efficiency 86,5 %
Power production ~ 29,9 %

Thermal Flow Diagram with Reheating



Gross Heat Release	MW	110
Throughput	Mg/h	27.3
LHV	MJ/kg	14.5
LSt Pressure	bar	90
LSt Temperature	°C	420

EfW Plant Berlin Ruhleben/ Germany 1/2

Location
Berlin Ruhleben, Germany

Purchaser
Berliner Stadtreinigungsbetriebe

Fuel
Municipal solid waste

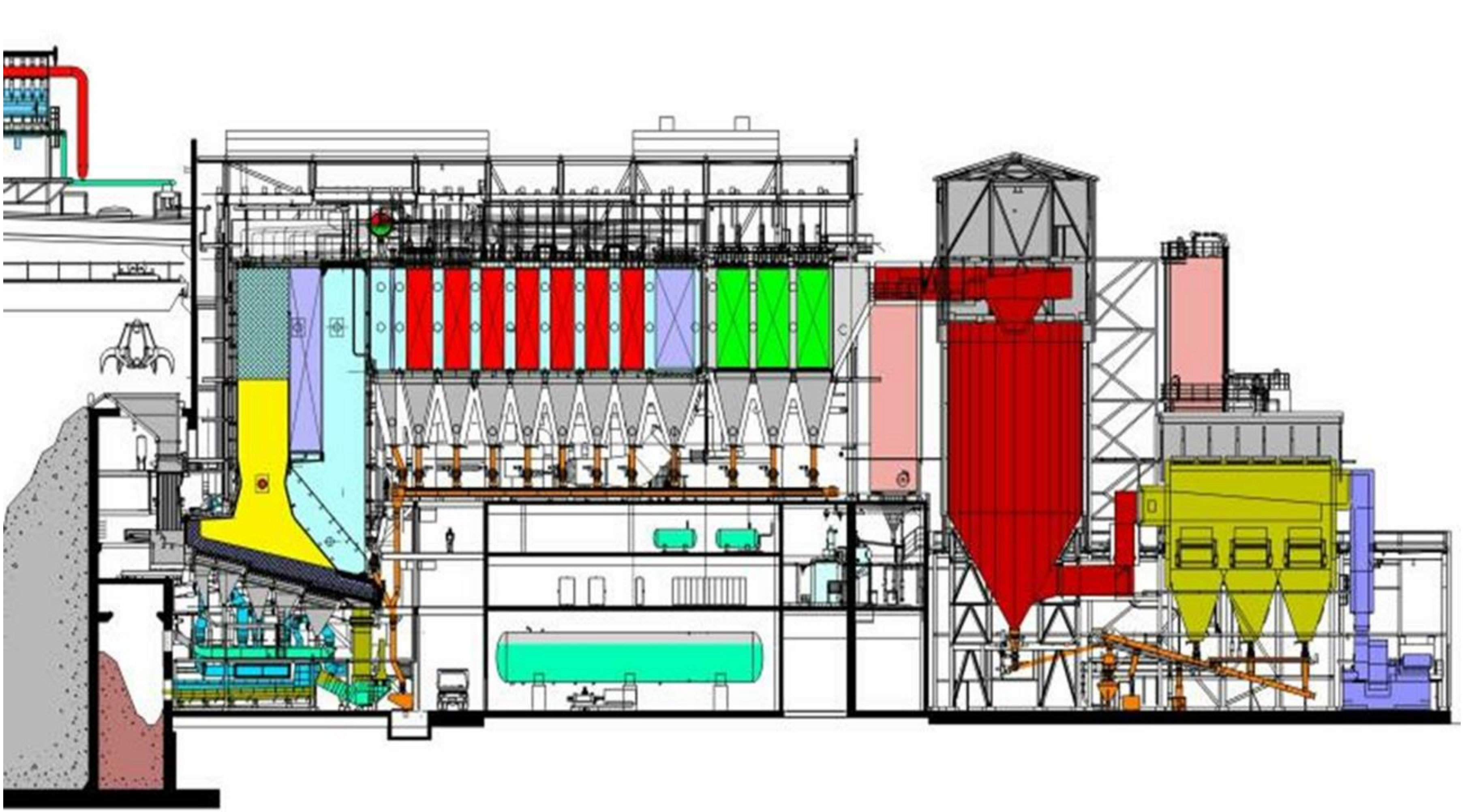
Capacity
90 MWth
1 x 36 t/h
9 000 kJ/kg

Grate System
Forward moving grate

Year of Start Up
2012

SBEng Scope of Supply
Turn-Key
(Replacement of 4 small units by one new line, incl. Flue gas cleaning, Civil, connecting work to the existing plant)

EfW Plant Berlin Ruhleben/ Germany 2/2



EfW Plant Linköping/ Sweden

Location
Linköping / Schweden

Purchaser
Tekniska Verken i
Linköping AB

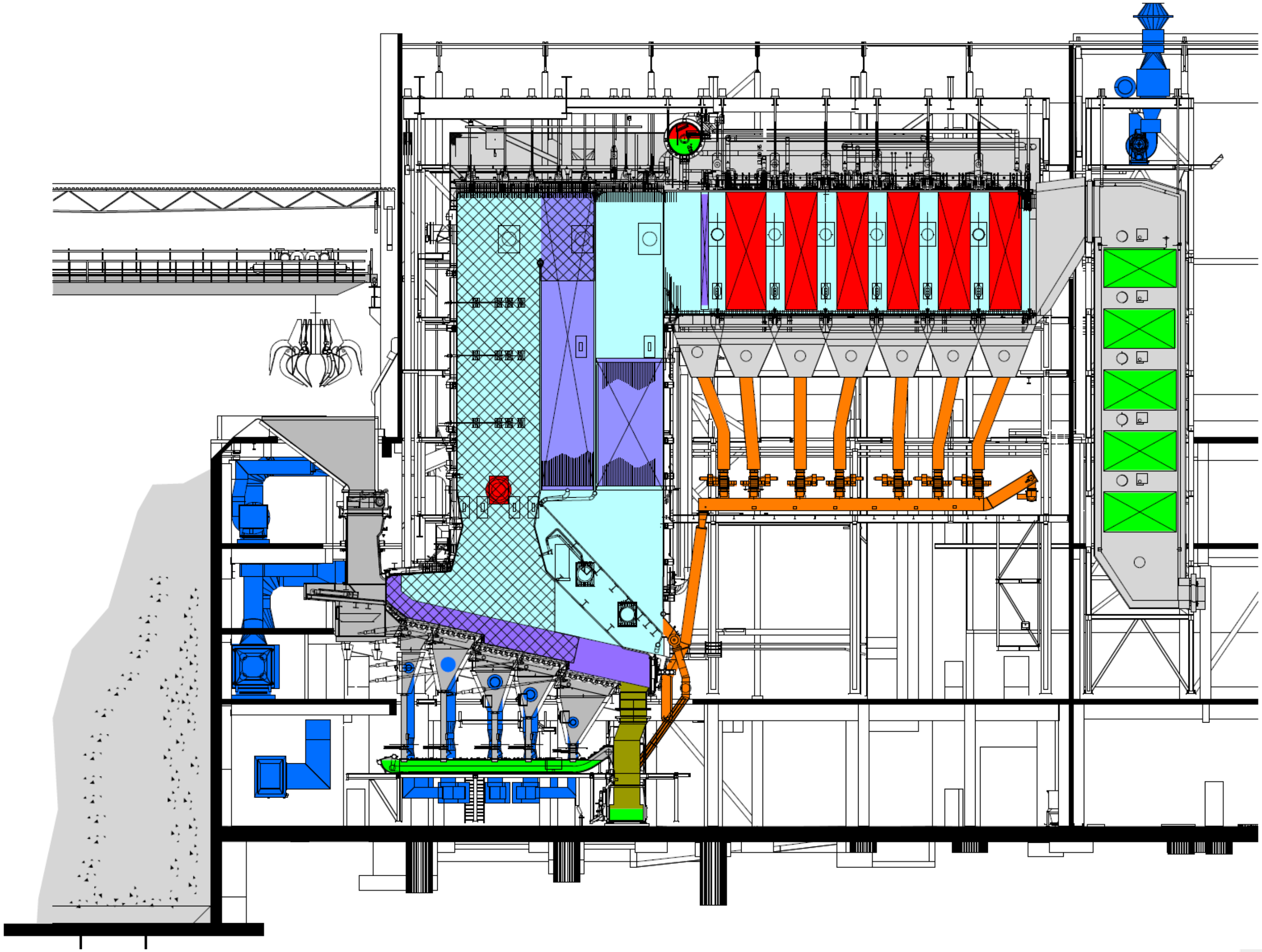
Fuel
Municipal Solid Waste &
Biomass

Capacity
88,14 MWth
1 x 30,22 t/h
10 500 kJ/kg

Grate System
Forward moving grate

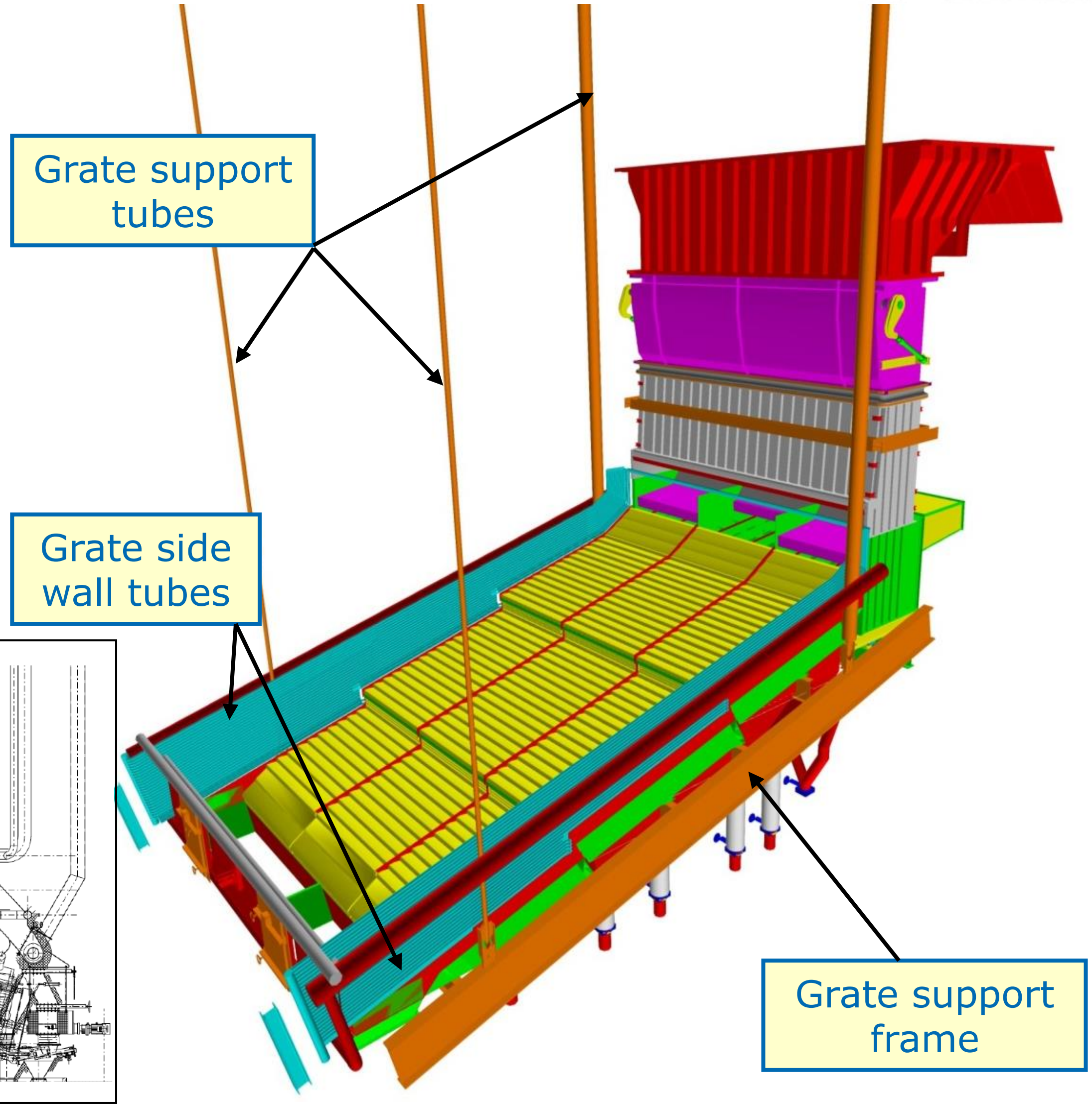
Year of Start up
2016

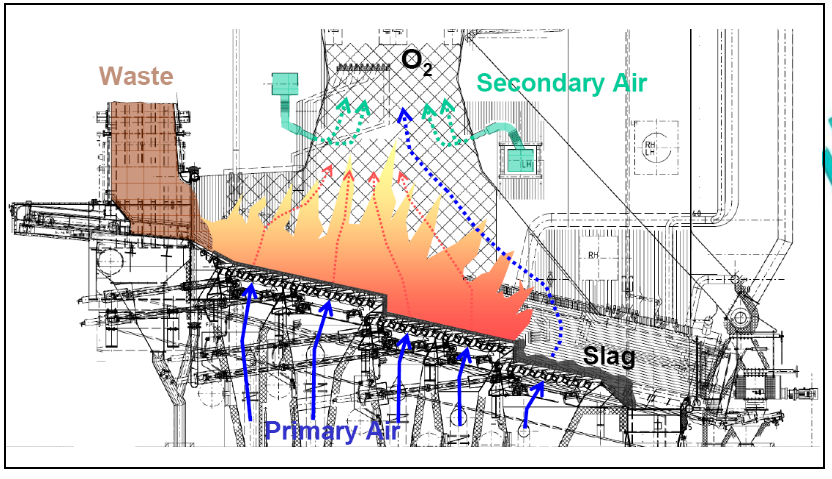
SBENG Scope of Supply
Grate Boiler /
Steam Generator /
Ancillary Equipment



Grate System

- Forward moving grate
- Air-cooled
- Inclination: 12.5 °
- No. of grate tracks: 3
- No. of grate zones: 5
- No. of grate steps: 2
- Grate length: 12.0 m
- Grate width: 9.475 m





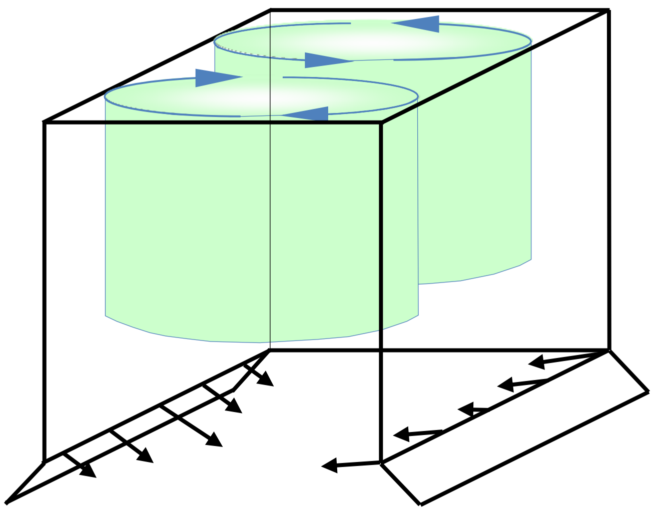
Furnace and 1st Boiler Pass

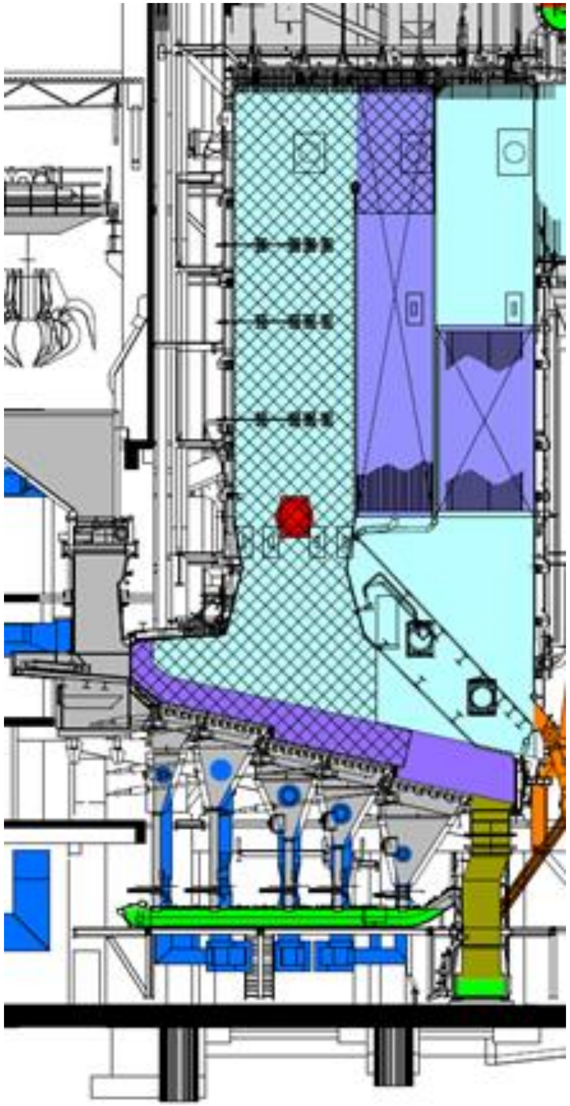
Furnace

- Centre flow configuration
- Excess air ratio 1,44
- Protection by Inconel cladding

Boiler

• Steam parameters	42,5 bar/ 400 °C	
• Steam mass flow	Mg/h	107,8
• Flue gas flow (MCR)	Nm3/h	150.536
• FG temperature	°C	165





Let‘s work it out together

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