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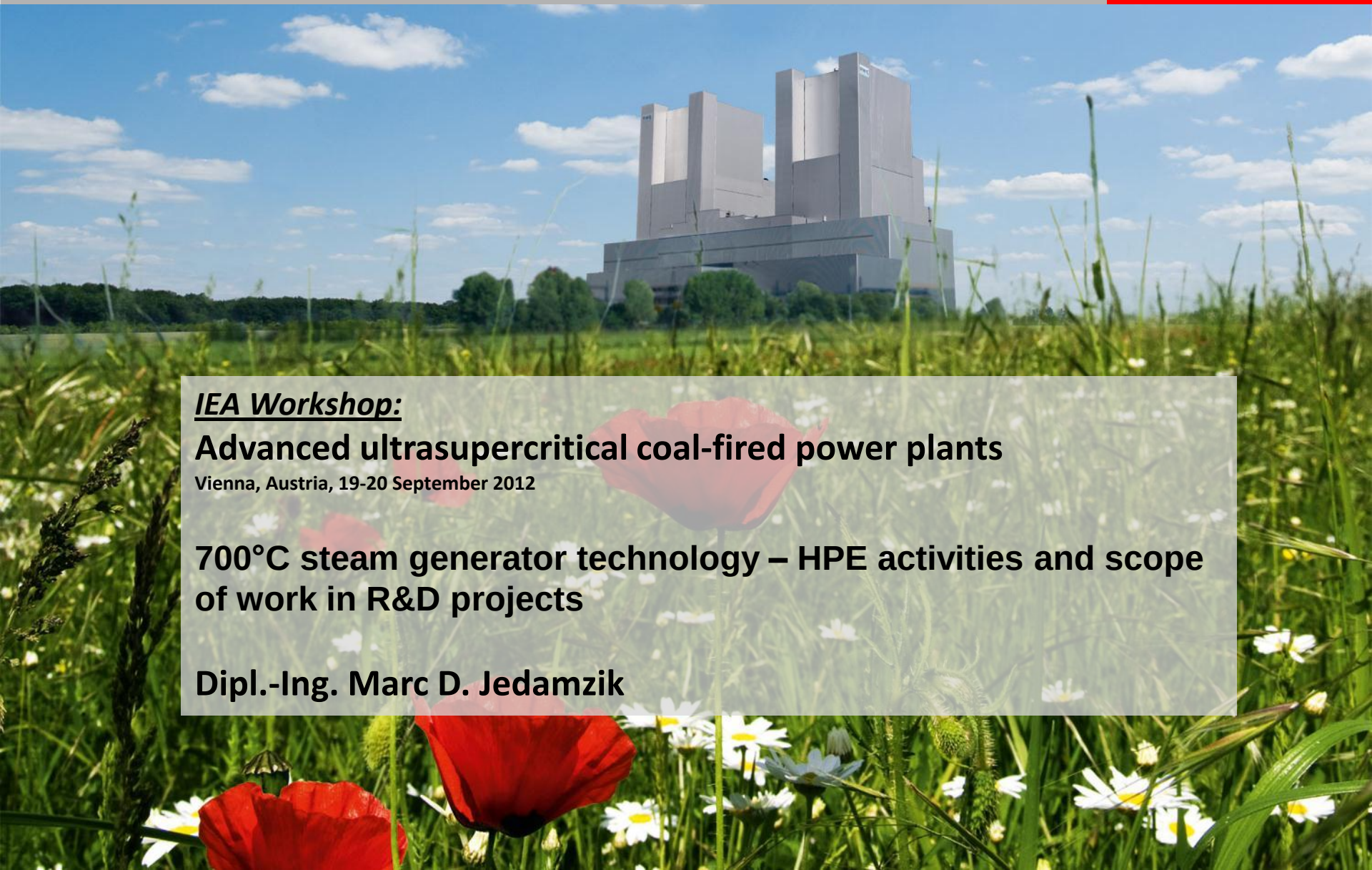

IEA Workshop:

Advanced ultrasupercritical coal-fired power plants

Vienna, Austria, 19-20 September 2012

700°C steam generator technology – HPE activities and scope of work in R&D projects

Dipl.-Ing. Marc D. Jedamzik

Hitachi Power Europe Group of companies

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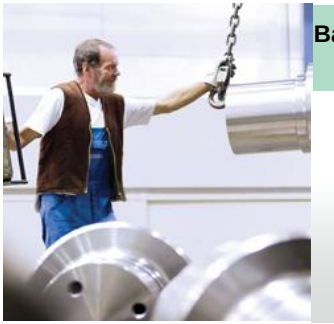

Babcock Fertigungszentrum Oberhausen GmbH

Production of first-class components for power plants (e.g. coal mill), mainly for Hitachi Power Europe

BGR Boilers Private Ltd.

Engineering, manufacture and delivery of utility steam generators in India

Donges SteelTec GmbH

One of Germanys leading steel and bridge constructors; manufacturing of steel structure for power plants

Hitachi Power Europe GmbH

- **Design and construction** of conventional fired power plants
- **Delivery of components** such as utility steam generator, environmental technology, turbines, milling plants

Hitachi Power Africa (Pty) Ltd.

Subsidiary of HPE in South Africa; construction and engineering of 12 utility steam generators for utility ESKOM

Hitachi Power Europe Service GmbH

Service, rehabilitation and components in the industrial plant field

Meeraner Dampfkesselbau GmbH

Manufacturing of premium components for utility steam generators (e.g. pressure parts) for power plants

Recent high efficient steam generators
Process parameters

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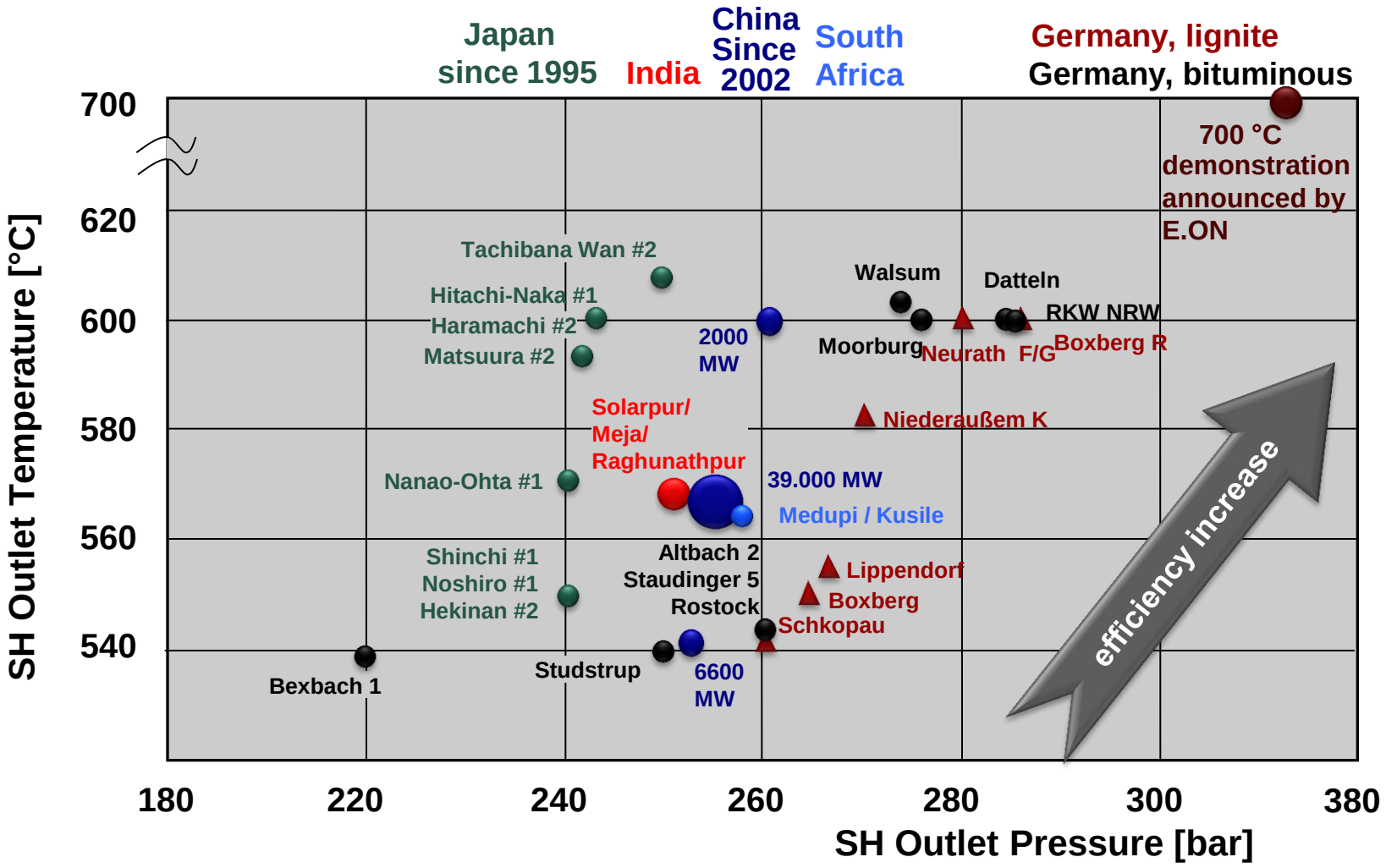
Actual running power plants projects in Germany marking the worldwide most modern state of the art



Lighthouse Projects
Development of the 700°C technology

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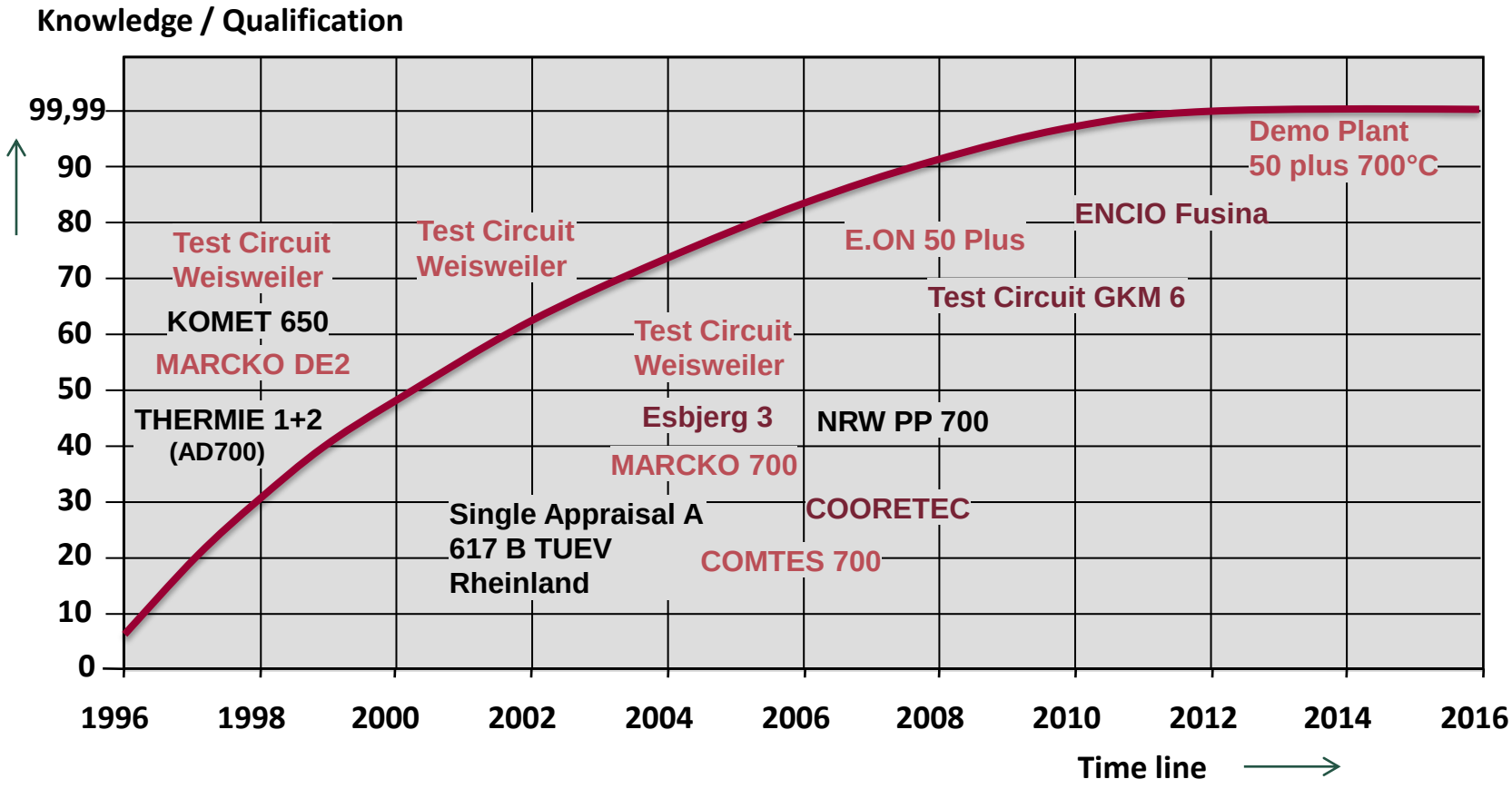
Testing and qualification programs for materials and components



Material development for future 700°C technology European funded R&D with participation of HPE

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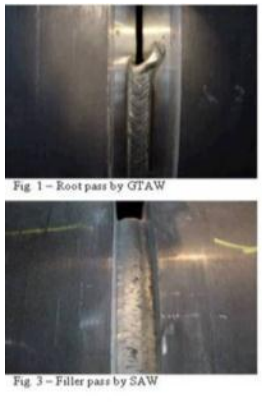
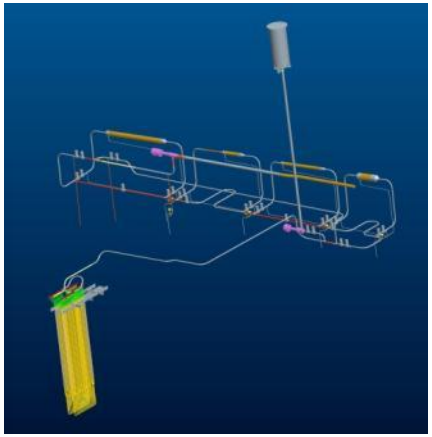
- **AD 700/1 01.01.1998-31.12.2001 (basics, materials)**



- **AD 700/2 01.01.2002-31.12.2006 (first component tests, weld tests)**

- **COMTES 700 (AD 700/3) 01.07.2004-31.12.2014 (component test facility for 700°C)**

- **ENCIO**
  2011-2017
  welding and repair concept
  Behaviour of different Ni based alloys
  HPE: coordinator engineering and manufacturing



AD 700 Phase 1 - Organisation

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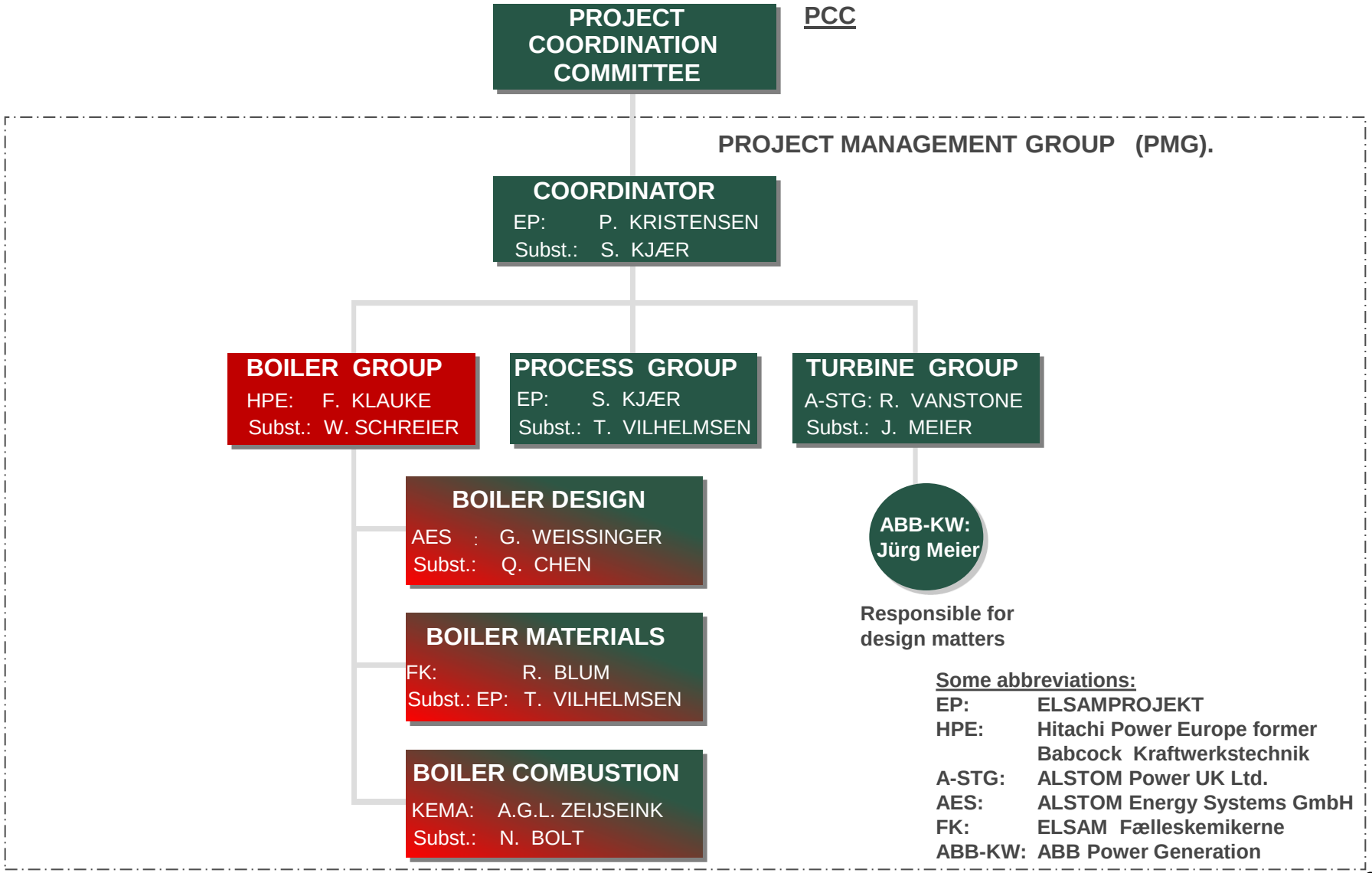

AD 700 – Subgroup Boiler Design

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Boiler Group, EC Contract No. SF/1001/97/DK

Boiler Design	400 MW		1000 MW	
Contractor	Tower	2 Pass	Tower	2 Pass
ABB-Enertech			2 RH, TF	
Ansaldo				2 RH, OWF
Hitachi Power Europe former Babcock Kraftwerkstechnik				1 RH, OWF
Babcock Wilcox Espaniola		1 RH, OWF		
Alstom Energy EVT / Stein	1 RH, TF			
Steinmüller	1 RH, OWF			
MITSUI Babcock				1 RH, OWF
Siemens KWU				1 RH, OWF
Stork		2 RH, OWF		

Legend: 1 RH = single reheat, 2 RH = double reheat, TF = tangential firing, OWF = opposed wall firing

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Main topics

- Fuel
- Corrosion
- Operation
- Emission
- Summerised guidelines for boiler specification

AD 700 - Subgroup Boiler Materials

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Development target

- **A ferritic pipe material**
  100 MPa / 650 °C / 10^5 h

- **An austenitic tube material**
  100 MPa / 700 °C / 10^5 h

- **One or two nickel base pipe/tube materials**
  100 MPa / 750 °C / 10^5 h

AD 700 - Alloy 263 for headers and piping

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Source: THERMIE AD 700 Program

AD 700 - An evaporator test panel from HCM12 and Alloy 617

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AD 700 – SAW of spin-casted Nickel based Alloy (o.D. 400 mm x 100 mm)

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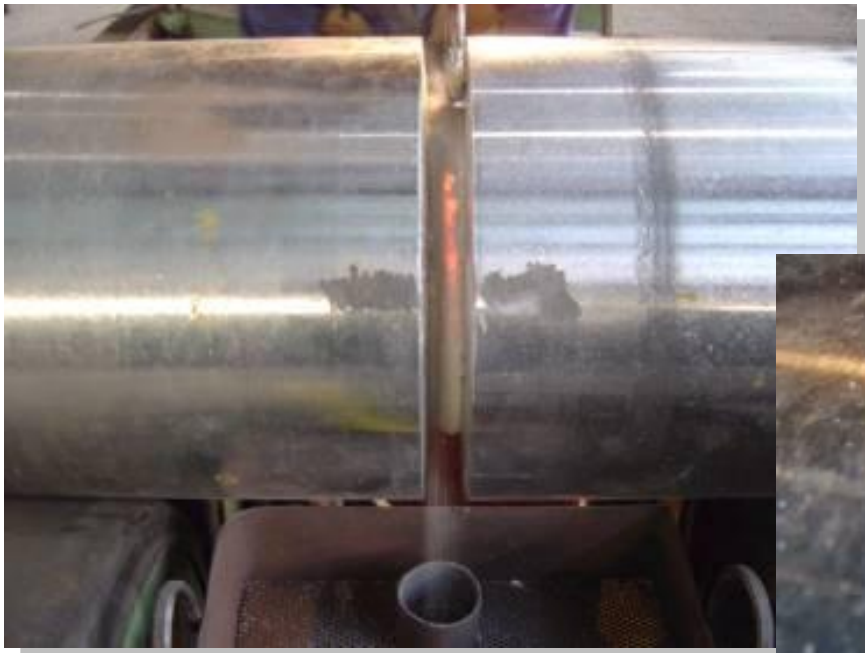
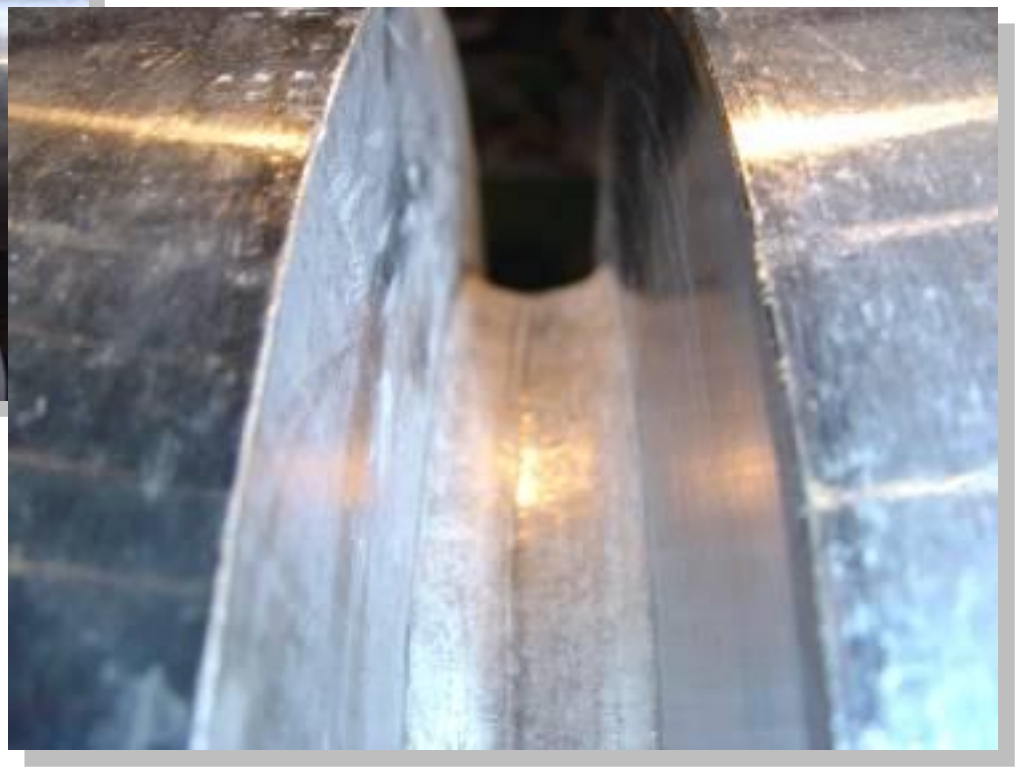
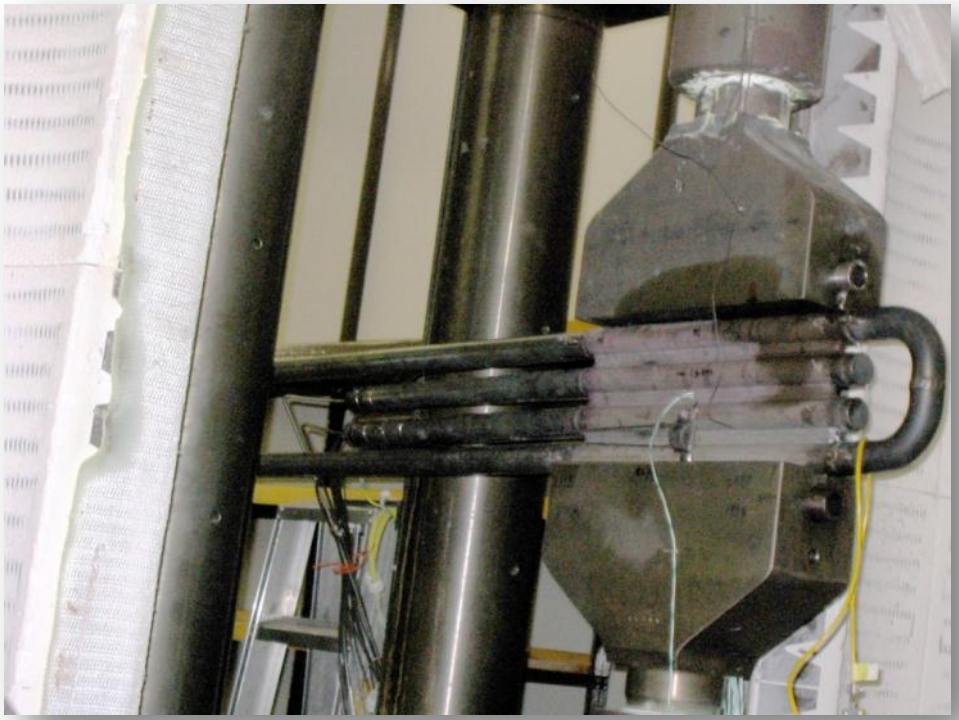


SAW filler pass



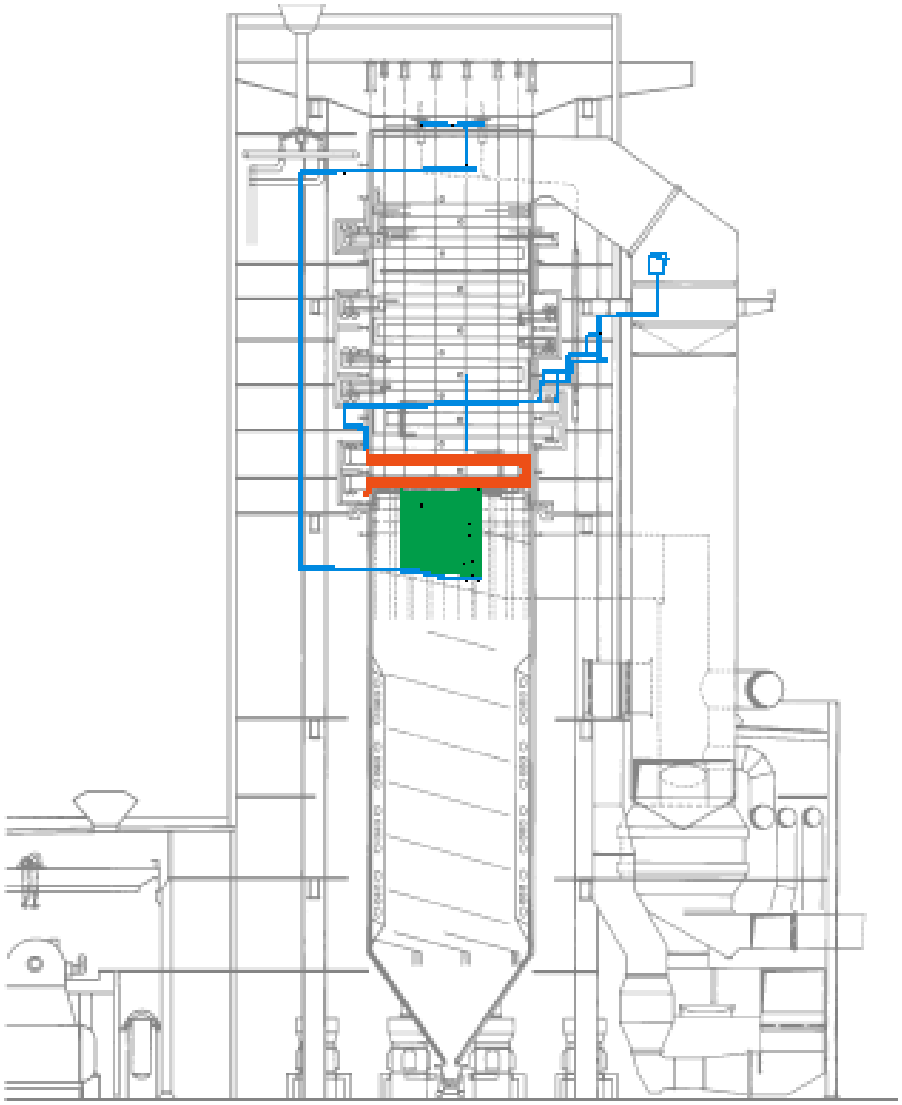
Source: Ansaldo

MARCKO 700 - Testing of membrane panel

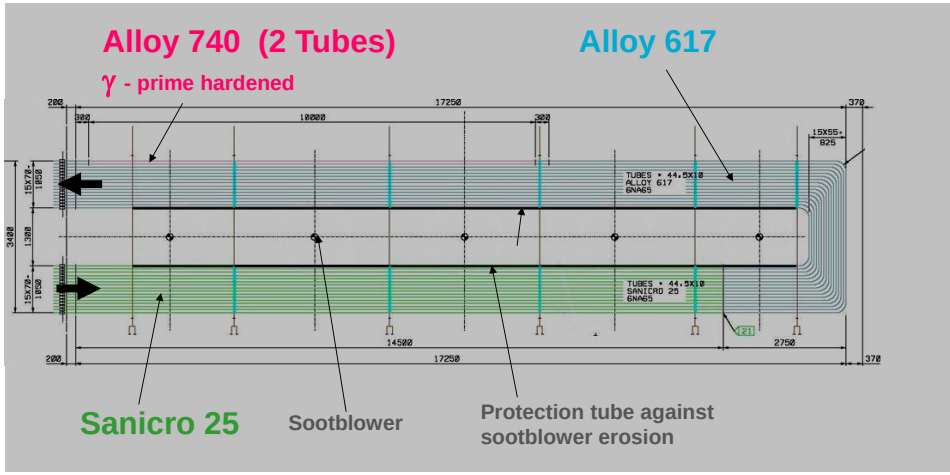


Source: MPA Stuttgart

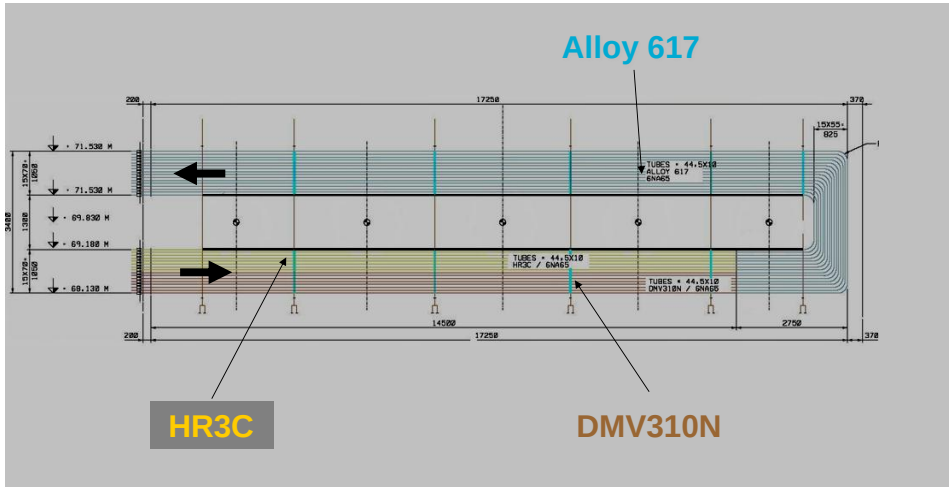
COMTES 700 - Arrangement



2. SH - Surfaces Loop A



2. SH - Surfaces Loop B



Manufacturing of heating surfaces for COMTES at our workshop in Meerane (MDKB)

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Forged and machined pipes Alloy 617 (o.D. 220 mm x 50 mm)

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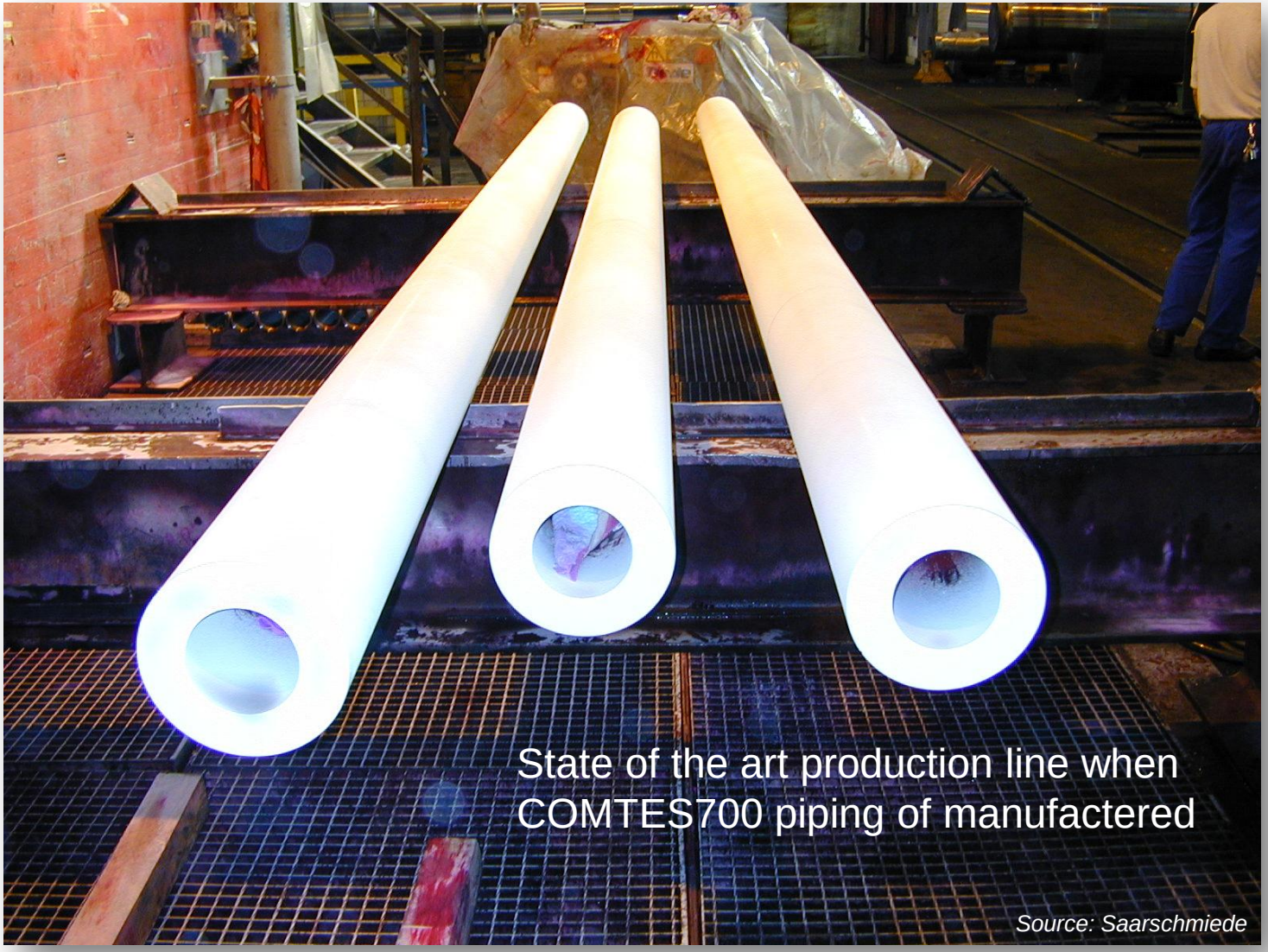

700°C Demo plant (E.ON) – HPE design

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550 MW	
High pressure part	
Steam rating	334kg/s; 1024t/h
Allowable operating pressure (gauge)	390 bar
SH-Outlet temperature	705 °C
Reheater	
Steam rating	285 kg/s
Allowable operating pressure (gauge)	81 bar
RH-Outlet temperature	720 °C

Manufacturing of Alloy 617B panel with different bend angles at our workshop in Meerane

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First hot pierced and drawn Reheater pipe Alloy 617B

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Hot wire narrow gap welding of Alloy 617B pipe (ø 350 OD x 72.5 [mm]) at Hitachi workshop

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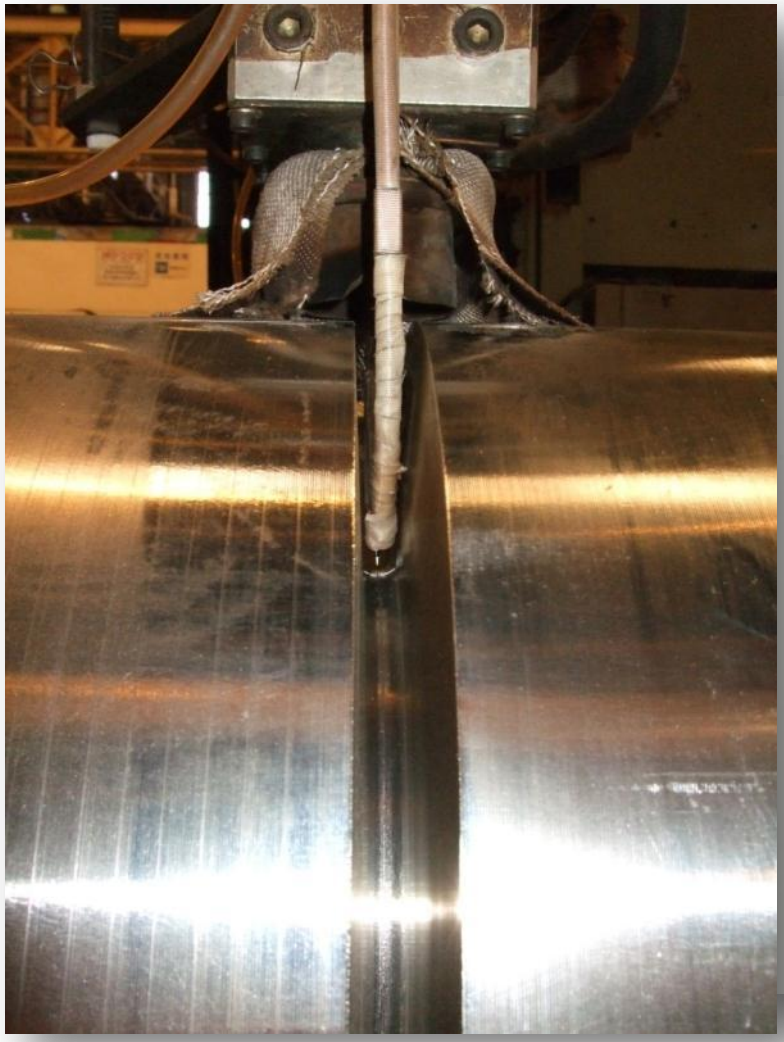
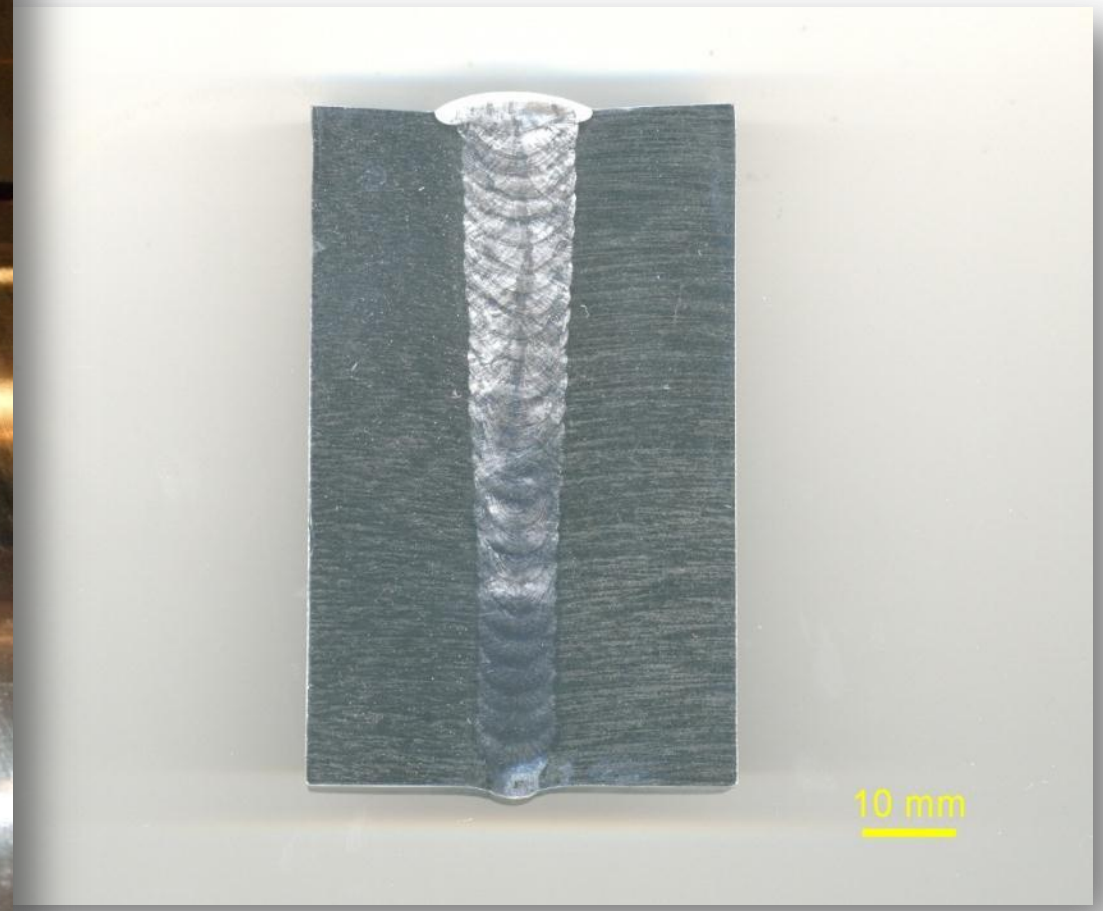
Welding process



Exellent result



Forging Alloy 617B, HP-Bypass

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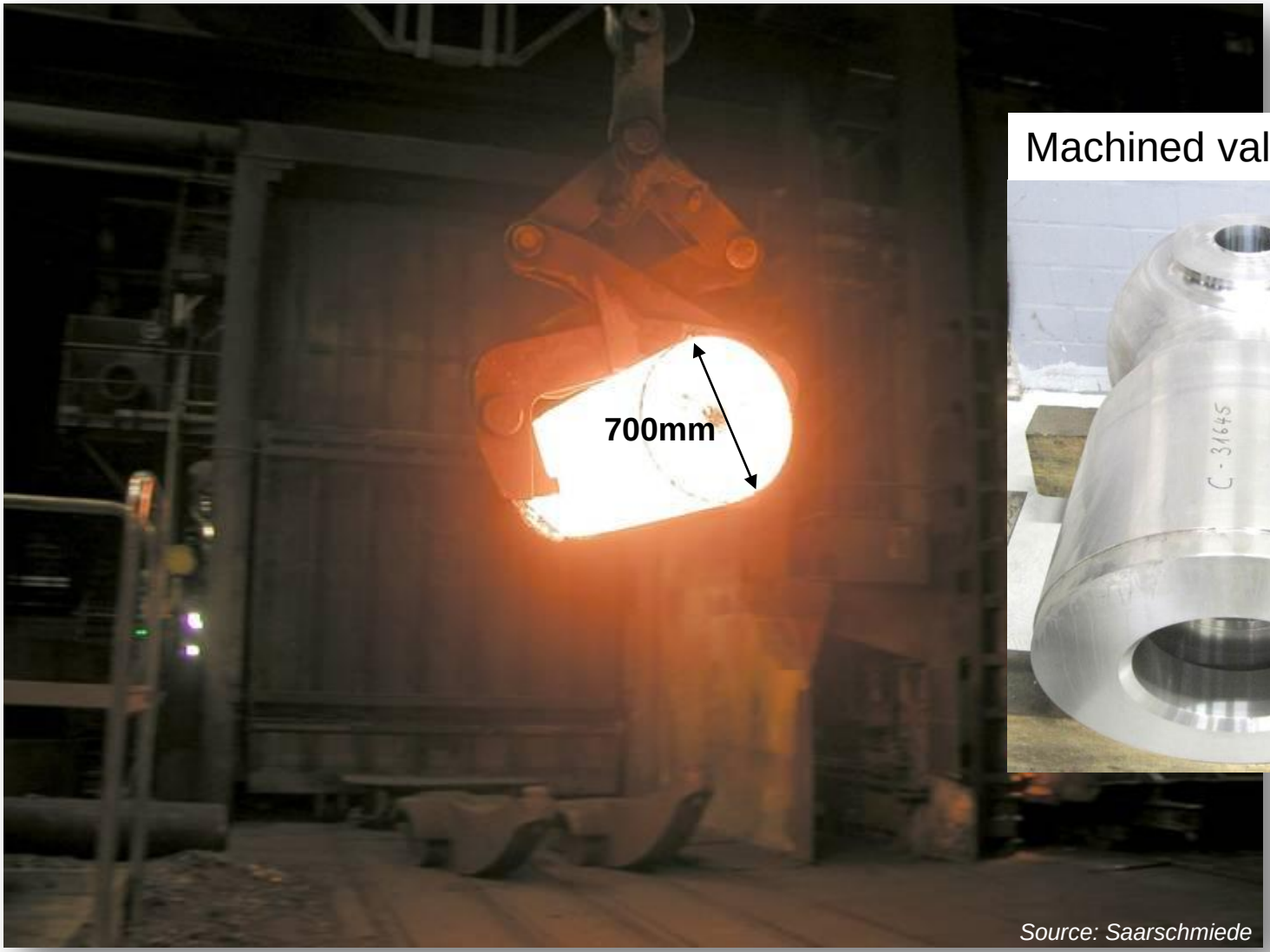

Machined valve body

Materials and components for 700°C technology
Forgings, valves

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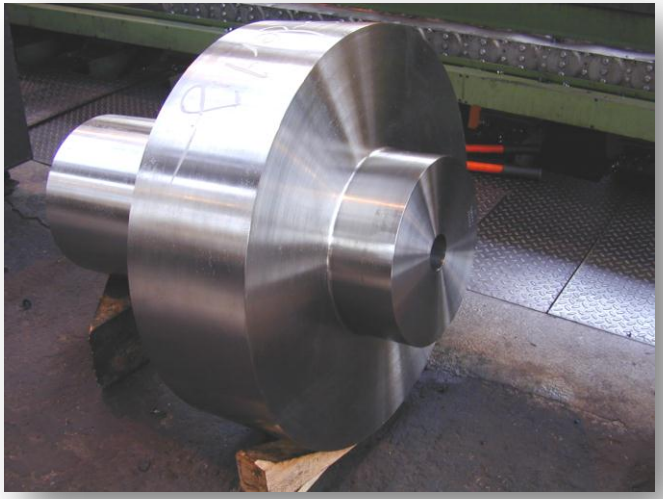

Candidate materials for 700°C Technology:

- Alloy 617B
- Alloy 617occ
- Alloy 263
- HR6W

} Ni-based alloys

Projects- HPE as Member of a Consortium

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	Project	Chairmanship	University or Laboratory
1	**Longitudinal welded pipe** Alloy 617B	Erndtebrücker Eisenwerke	MPA University of Stuttgart
2	**DATA MINING:Use of neural network for the determination of the heat specific creep rupture behaviour** Alloy 617 – Alloy 617B	**HPE**	MPA University Stuttgart
3	**Design criteria and advanced assessment methods for design by analysis of boiler components using numerical methods** T24, P92, Alloy 617	**HPE**	MPA University of Stuttgart
4	**Calculation by FEM and Mock-up Tests of advanced headers** P92, Alloy 617B, Sanicro25, DMV304HCu, DMV310N	**HPE**	IfW TU of Darmstadt
5	**Influence of B on creep resistance of** Alloy 617	**Secretary HPE**	SZMF Duisburg
6	**Basic investigation on** Alloy A617 / Alloy 617B	**HPE / VDM**	TTZ University of Braunschweig
7	**Basic investigations on different heats of** Alloy 617B	**HPE**	Centro Sviluppo Materiali S.p.A, Rome (CSM), Italy
8	**CSR – Tests of Alloy 617B** Alloy 617B	**HPE**	IfW TU of Darmstadt
9	**CSR – Tests in vacuum/air of** Alloy A617 / Alloy 617B	**HPE**	IfW University of Siegen
10	**Corrosion tests in oxyfuel atmosphere** T24, T11, VM12, Super304H, HR3C, Sanicro25, Alloy 617B, Alloy 740	**HPE**	Dechema Frankfurt

Public funded HPE-Projects

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	Project	Chairmanship	University or Laboratory
1	**MARCKO 700** **Material qualification for 700/720°C-Power Stations** T24, VM12, P92, A 617B	**HPE**	MPA University of Stuttgart
2	**COMTES 700** T24, HCM12, P92, Sanicro 25, HR3C, DMV310N, Alloy 740, Alloy 617B	VGB	Main investigator **HPE Laboratory**
3	**COORETEC DE4** Alloy C263, Alloy 617 Piping, Forgings, Tubing, Castings, Qualification Programme	**HPE**	MPA University of Stuttgart, IfW TU of Darmstadt
4	**COORETEC TD1** Non-destructive testing of Nickel Alloys, Alloy 617, Alloy 625	VGB	BAM Berlin, IGZFP Saarbrücken, MPA University of Stuttgart
5	**Cold forming of SH 700°C candidate tube material** DMV4910, DMV304HCu, DMV347HFG, DMV310N, AC66, Sanicro25, Alloy 617B, Alloy 263, Alloy 740	**HPE**	IfW TU of Darmstadt
6	**COORETEC DE1** Corrosion and high temperature behaviour of 700 °C candidate materials T92, VM12, DMV4910, DMV304HCu, DMV347HFG, DMV310N, AC66, Sanicro25, Alloy 617B, Alloy 263, Alloy 740	WG 1 -5 several	IWBT Braunschweig, IEF, FZ Jülich, MPA University of Stuttgart, IVD Stuttgart, Main Investigator **HPE Laboratory for WG1**

ENCIO Project - **E**uropean **N**etwork for **C**omponent **I**ntegration and **O**ptimization

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Aim of ENCIO

Qualify materials, components, manufacturing, erection and repair methods for realization of a 700°C Power Plant

- Repair methods for aged material, which has already been in operation (COMTES 700)
- Hot-Isostatic-Pressing components (HIP)
- Lifetime Monitoring for 700°C components
- New materials for thick-walled components
- Turbine cast weld seams

ENCIO Project – Structure, European Network for Component Integration and Optimization

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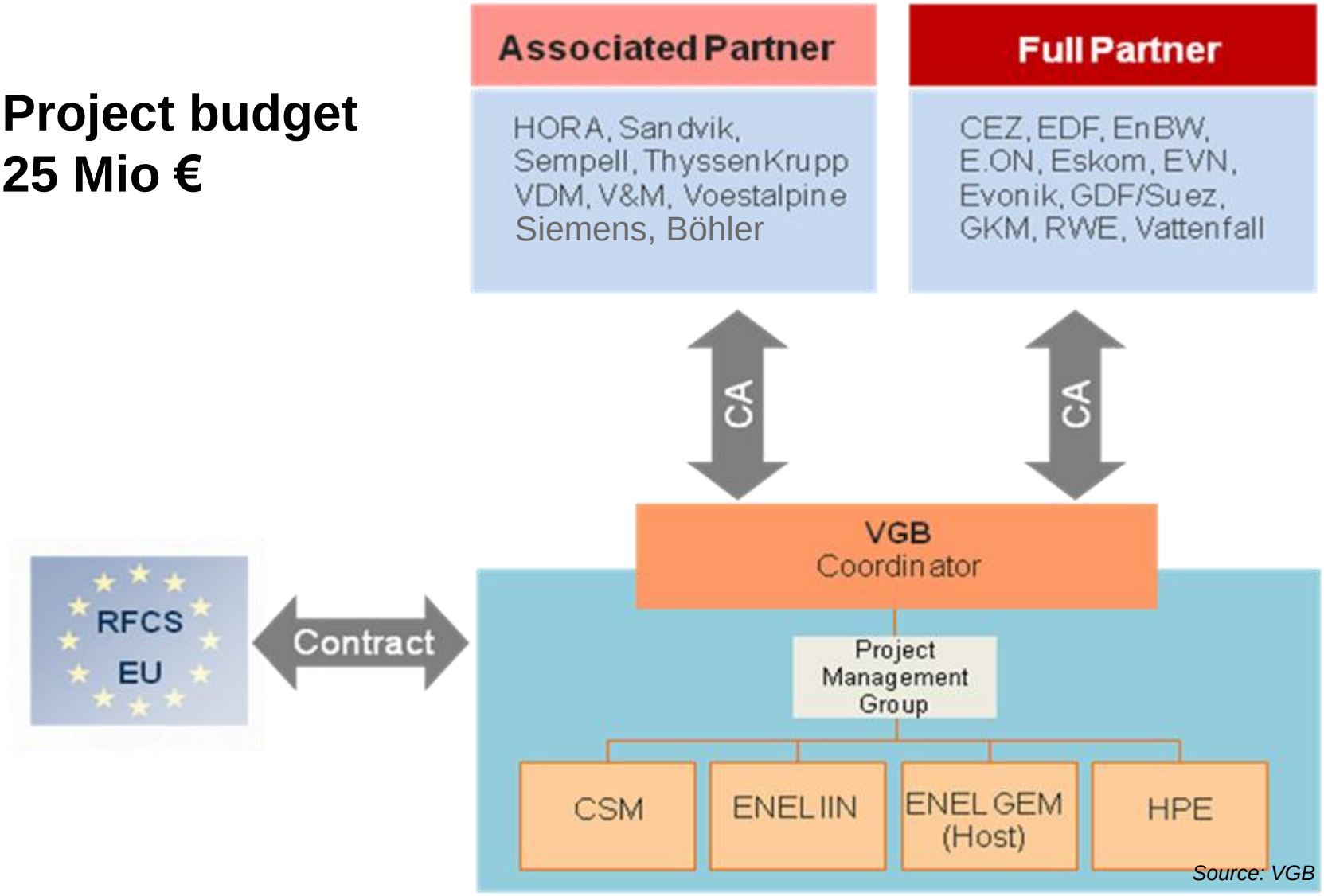
Project budget
25 Mio €



ENCIO Test Facility - **E**uropean **N**etwork for **C**omponent **I**ntegration and **O**ptimization

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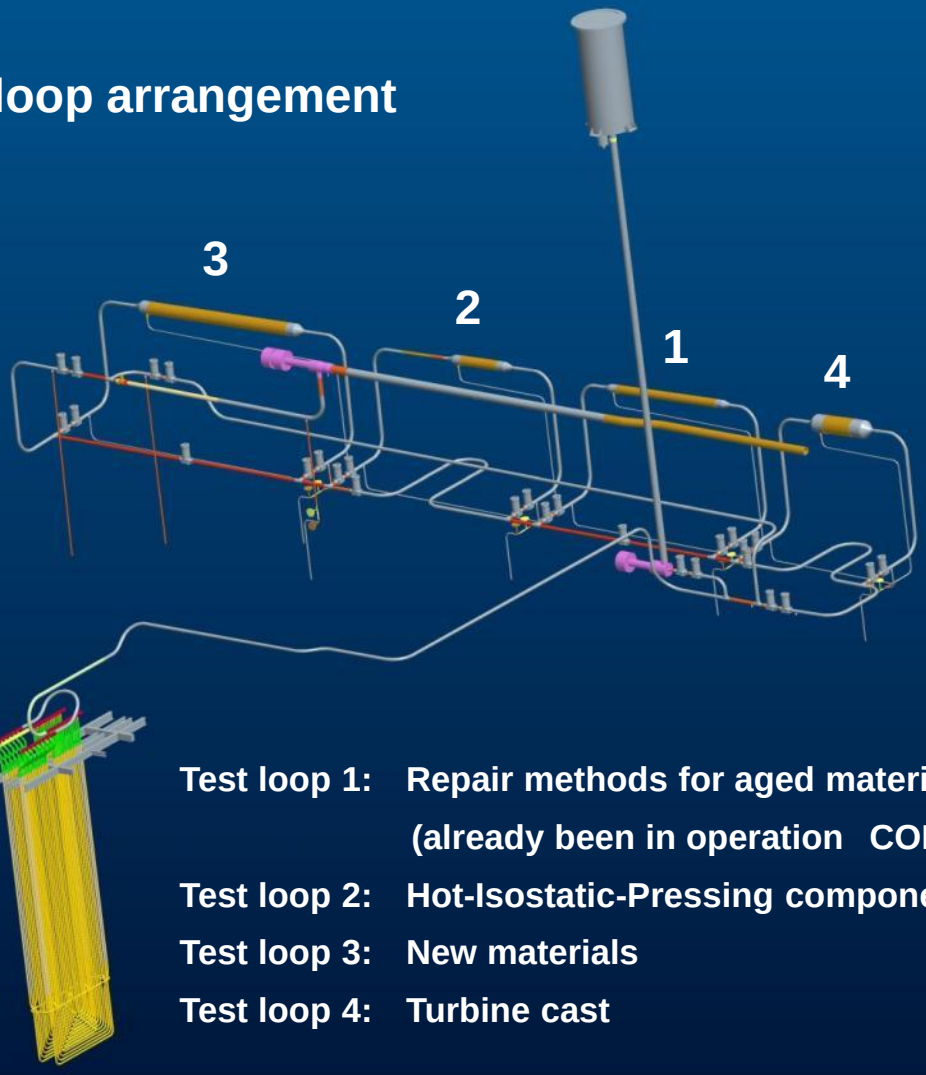
Test loop arrangement



Test loop 1: Repair methods for aged material
(already been in operation COMTES 700)

Test loop 2: Hot-Isostatic-Pressing components / Lifetime Monitoring

Test loop 3: New materials

Test loop 4: Turbine cast

COMTES Alloy 617B - Stop valve after operation of 22000 h, HPE task force leader of investigation group

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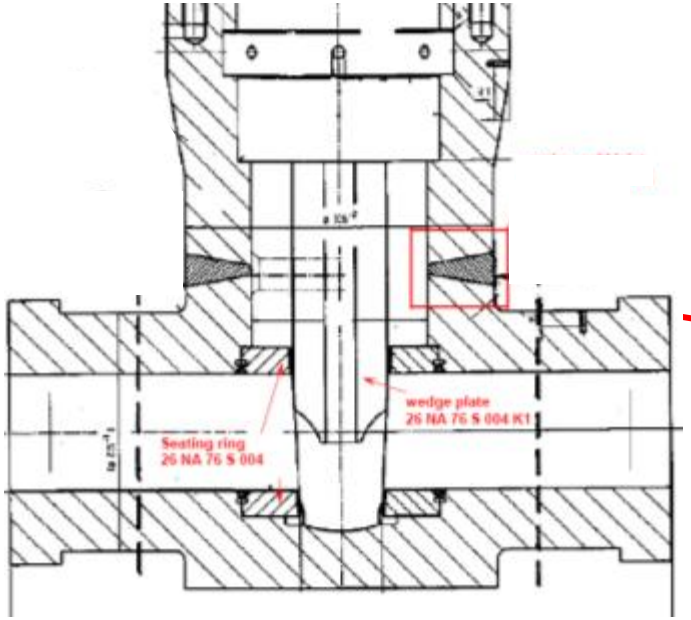
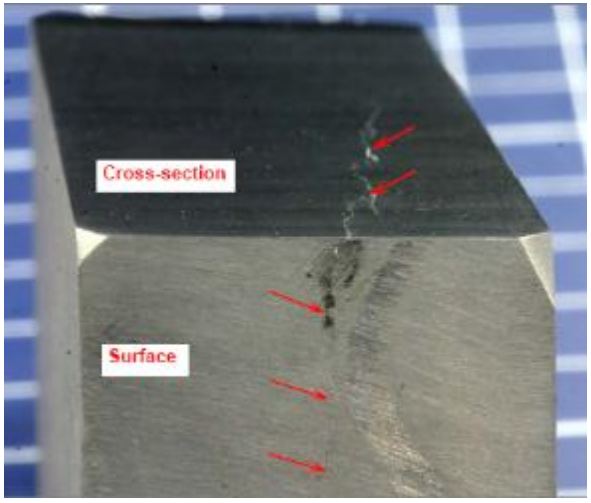
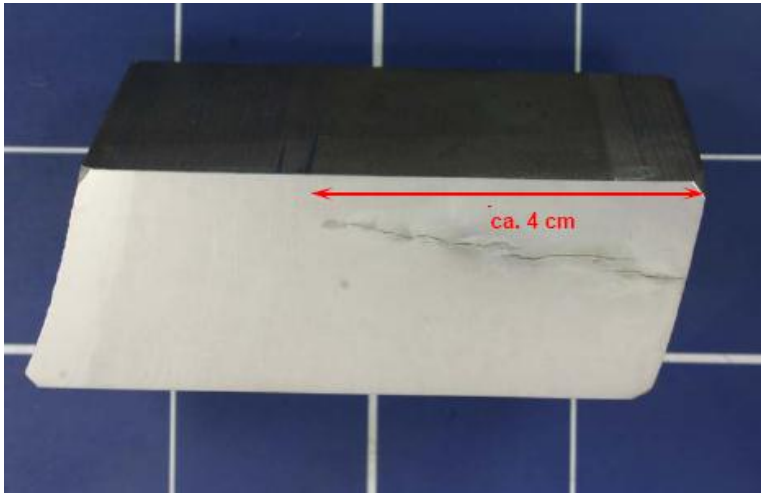


PT



Source: Sempel/RUB



ENCIO, European Network for Component Integration and Optimization

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courtesy of ThyssenKrupp VDM GmbH

Monobloc forging of valve bodies

Cutted raw forging of valve body

courtesy of SEMPELL GmbH

Valve body pre-machined

courtesy of SEMPELL GmbH

HITACHI Power Europe GmbH
Schifferstraße 80
D-47059 Duisburg
- G E R M A N Y -

AD 700 - Material testloop for 720 ºC steam temperature (corrosion, oxidation)

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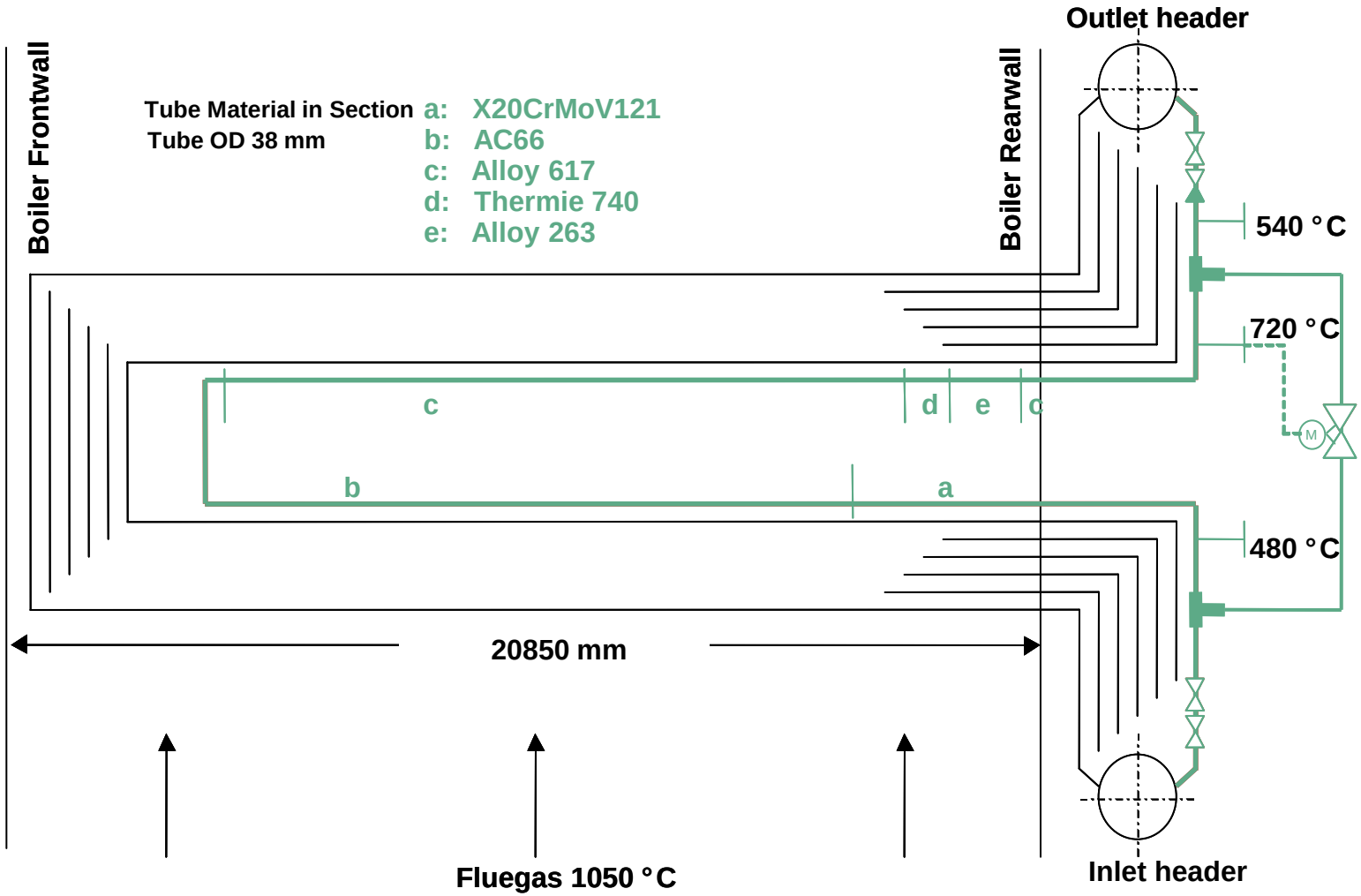
Installed in the final superheater of the lignite fired PS Weisweiler (tower type)



Common project of AD700 and MARCKO