High Pressure Piping in Power Plants – Water / Steam Cycles

Capital Markets Day “Power Services“ at Moorburg Power Plant

December 2, 2010

Ronald Diehl, Member of the Executive Board of BB Power Services GmbH
Agenda

1. Overview division
   Piping Technology
2. High-Pressure Piping Systems
3. Service Range
4. Market Structure
5. Clients
6. Contract Types
7. Competitive differentiators and success factors
8. References
1. Overview division Piping Technology

Bilfinger Berger activities in the power plant sector

Fields of competence

Service range

- Project management
- Basic Engineering (Process engineering, E/I&C, Arrangement planning)
- Detail engineering
- Manufacturing, Fabrication
- Steel construction, manlifts, facades, hoists
- Construction, Erection
- Quality assurance, welding technology
- Commissioning, Bringing into operation
- Procurement

Planning teams

- Steam generator, firing system
- Components: coaling, mill, ash removal, heat recovery
- Piping HP system
- IP system
- LP system
- DeNOx Electrostatic precipitator
- Desulfurization
- Induced draft fan
- Forced draft fan
- Construction services (Bilfinger Berger Civil)
1. Overview division Piping Technology
Power Services Companies active in Piping Technology

Bilfinger Berger SE

Bilfinger Berger Power Services GmbH

Steam Generators
- Babcock Borsig Service GmbH
- Steinmüller Instandsetzung Kraftwerke Gesellschaft für Energie- und Umwelttechnik mbH
- Deutsche Babcock Middle East FZE (UAE)
- Duro Dakovic Montaza d.d. (Croatia)
- Rotring Engineering AG

Steam Generators South Africa
- Bilfinger Berger Power Holdings (Pty) Ltd.
- Steinmüller Africa (Pty) Ltd.
- Steinmüller Engineering Services (Pty) Ltd.
- KOG Group
- Intervale (Pty) Ltd.

Energy and Environmental Engineering
- Babcock Noell GmbH

Piping Technology
- BHR Hochdruck-Rohrleitungsbau GmbH
- PKB Planungsbüro Rohrleitungs- und Anlagentechnik GmbH
- BHR Piping Systems (Pty) Ltd. (South Africa)
- MCE Berlin GmbH

Mechanical Apparatus and Plant Engineering
- MCE Maschinen- und Apparatebau GmbH & Co. KG (Austria)
- MCE Industrietechnik Aschersleben GmbH

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1. Overview division Piping Technology
Development and volume forecast

Orders received and output volume include between €120m and €150m / year standard business (service).
2. High-Pressure Piping Systems

Power plant types

Water/steam cycles in thermal power plants are the connections between the feed water pumps, the boiler / heat exchanger and the turbine.

- Coal-fired power plants
- Lignite-fired power plants
- Nuclear power plants
- Combined-cycle power stations
- Biomass power plants
- Surrogate fuel power plants
### 2. High-Pressure Piping Systems

BoA power plant – reference

#### RWE Neurath lignite-fired power plant

(optimised plant design, BoA), 1,100 MW

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total material</td>
<td>approx. 3,100 t/ unit</td>
</tr>
<tr>
<td>Pipes</td>
<td>approx. 2,200 t</td>
</tr>
<tr>
<td>Form pieces</td>
<td>approx. 115 t</td>
</tr>
<tr>
<td>Fittings</td>
<td>approx. 190 t</td>
</tr>
<tr>
<td>Supports/hangers</td>
<td>approx. 600 t</td>
</tr>
<tr>
<td>Total pipe length</td>
<td>approx. 11,000 m</td>
</tr>
<tr>
<td>Main piping</td>
<td>approx. 4,400 m</td>
</tr>
<tr>
<td>Total circumferential welds</td>
<td>approx. 7,000</td>
</tr>
<tr>
<td>Total circumferential welds of main piping</td>
<td>approx. 1,400</td>
</tr>
</tbody>
</table>
2. High-Pressure Piping Systems
BoA power plant – reference

RWE Neurath lignite-fired power plant
(optimised plant design, BoA),
1,100 MW

- **Feed water**
  430 bar, 250 °C, Ø 588 mm, w.th. 44

- **Main steam**
  295 bar, 610 °C, Ø 549 mm, w.th. 97

- **Cold reheat**
  75 bar, 435 °C, Ø 824 mm, w.th. 31

- **Hot reheat**
  70 bar, 615 °C, Ø 806 mm, w.th. 43
### 3. Service range
High, intermediate and low pressure piping

#### Engineering
- Piping conceptual / basic design
- Piping detail design
- Pressure design
- System analysis
- Stress calculation
- Pipe hanger design
- Project management

#### Manufacturing
- Fabrication of piping spools
  - Bending
  - Welding
  - Heat treatment
  - Machining
  - Destructive and non-destructive material testing

#### Erection
- Assembly of the prefabricated pipe spools and hangers
  - Power plant new builds
  - Replacement during power plant outages

#### Service
- Plant maintenance consulting service
- Plant maintenance engineering
- Plant optimization
- Power plant retrofits
- Assessment of residual service life

#### Procurement
- Expediting
- Specifications
- Quality Assurance
- Scheduling
4. Market Structure
Position in Target Markets

**High-Pressure Piping Systems**
Market leader in Europe
Market leader in South Africa
One of six leading contractors worldwide

**Piping Systems in Nuclear Power Plants**
Market leader in Europe

**Main Coolant Piping in Nuclear Power Plants**
(internally cladded pipes)
One of three contractors worldwide
4. Market Structure

Competitors

<table>
<thead>
<tr>
<th>Region</th>
<th>Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>KAM (Kraftanlagen München)</td>
</tr>
<tr>
<td></td>
<td>BIP (Babcock Industry and Power)</td>
</tr>
<tr>
<td></td>
<td>E.ON Anlagenservice</td>
</tr>
<tr>
<td></td>
<td>WWV (Wärmeverwertung)</td>
</tr>
<tr>
<td>Europe</td>
<td>YIT (Industrial and Network Services), Finland</td>
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<tr>
<td></td>
<td>Fives Nordon, France</td>
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<tr>
<td></td>
<td>Fabricom (Suez Gaz de France), Belgium</td>
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<tr>
<td></td>
<td>Boccard, France</td>
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<tr>
<td></td>
<td>Bassi, Italy</td>
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<tr>
<td></td>
<td>Integral, Austria</td>
</tr>
<tr>
<td>World</td>
<td>Shaw / Stone &amp; Webster, USA</td>
</tr>
<tr>
<td></td>
<td>Bentec, USA</td>
</tr>
<tr>
<td></td>
<td>ATE (Atomtech Energy &amp; Industrials), Taiwan</td>
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<tr>
<td></td>
<td>BHEL (Bharat Heavy Electricals Ltd.), India</td>
</tr>
<tr>
<td></td>
<td>Seongwha Industrial, Korea</td>
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<tr>
<td></td>
<td>Fabricom / Endel (Suez Gaz de France), Belgium/France</td>
</tr>
</tbody>
</table>
5. Clients

Top ten operators and turnkey suppliers / general contractors
6. Contract Types

- **Hourly rates**
  - Billing on basis of hours and material spent according to unit rate list

- **Lump sum**
  - Client BBPS
  - Lump sum fixed price for exactly defined scope of supplies and services
  - e.g. water/steam cycles

- **Unit price contract**
  - Client BBPS
  - Unit rate lists with defined quantities
  - e.g. major contract OL3 Finland
    - AREVA reactor building
    - SIEMENS turbine hall

- **Cost plus fee**
  - Client BBPS
  - Hours spent with hour charge rates
  - all materials and third-party services (cost plus fee)
  - – no major contracts –
Higher process temperatures and pressures …

… increase net efficiency and reduce CO2 emissions.

… require better materials with higher demands for development, manufacturing and fabrication.

Process temperature

gram CO₂ per kWh

0

10

20

30

40

50

60 %

0

10

20

30

40

50

60

70


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7. Competitive differentiators and success factors

**Competitive differentiators**

- More than 100 years of expertise and know-how from
  - Mannesmann Anlagenbau (MAB), today BHR
  - Babcock Rohrbau, today BHR

- Close cooperation with world market leader Vallourec & Mannesmann (V&M), formerly Mannesmann Röhrenwerke
  - Global leader in equipping power plants with seamless pipes for high-pressure piping systems

- Joint research projects with Vallourec & Mannesmann (V&M)
  - Ongoing development and improvement of pipe materials (V&M) and their process technologies (BHR)
7. Competitive differentiators and success factors
Core competence
Process engineering and design calculation

Pressure surge calculation of the main steam piping system

- Turbine safety shutdown in max. 150 milliseconds
- Velocity of steam flow up to approx. 210 km/h
7. Competitive differentiators and success factors

Core competence
Detail engineering and calculation

Control of forces and loads
Transfer of forces and loads into the building steel structure by means of Lisega Pipe Hangers

- Rigids
- Constant hangers
- Shock absorbers
- Spring hangers
7. Competitive differentiators and success factors

Core competence

The key technologies

<table>
<thead>
<tr>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductive bending</td>
</tr>
<tr>
<td>Submerged arc welding (SAW)</td>
</tr>
<tr>
<td>SAW socket welding</td>
</tr>
<tr>
<td>SAW-narrow gap welding</td>
</tr>
<tr>
<td>Weld cladding</td>
</tr>
<tr>
<td>Manual arc welding</td>
</tr>
<tr>
<td>Inert-gas tungsten-arc welding (TIG)</td>
</tr>
<tr>
<td>TIG pulse orbital narrow gap welding</td>
</tr>
<tr>
<td>Heat treatment</td>
</tr>
<tr>
<td>Material testing non-destructive / destructive</td>
</tr>
</tbody>
</table>
7. Competitive differentiators and success factors

Example: Key technology inductive bending

- Production of bends with flow optimised radii
  = minimised pressure loss

- Reduction of number of welds
  = increased benefit
7. Competitive differentiators and success factors
Example: Key technology inductive bending

Movie Inductive Bending
7. Competitive differentiators and success factors
Successful in the market

Coal- and lignite-fired big sized power plant new builds in Germany

- Number of power plant units (14)
  - Number of BHR projects (12)
8. References

High-pressure piping in nuclear power plants
Olkiluoto 3, Finland, EPR 1,600 MWe
8. References
High-pressure piping in nuclear power plants
Olkiluoto 3, Finland, EPR 1,600 MWe
8. References
High-pressure piping in nuclear power plants
Olkiluoto 3, Finland, EPR 1,600 MWe
8. References
High-pressure piping in thermal solar power plants
Water / Steam Cycles

Photo: Siemens press release
8. References
High-pressure piping in thermal solar power plants
Water / Steam Cycles
8. References
Piping solutions in offshore wind power plants
Steel pipes for offshore foundations
Strong arguments for a successful expansion of the share in the worldwide power piping market

Thank you for your attention