Agenda

About VPC
Services Portfolio
Experience & Customers
Shareholder
palero

Range of services
Engineering services for power generation plants and distribution systems

Sales
46.6 million euros*

Workforce
1,040

Subsidiaries
• Lausitzer Analytik GmbH (approx. 100 employees)
• VPC East d.o.o., Serbia (approx. 15 staff)
• Encotec Energy (India) Pvt. Ltd. (approx. 700 employees)

Certified to
ISO 9001, ISO 14001, OHSAS 18001, KTA 1401, SCC, DAkkS Accreditation

* as at 31st December 2016
palero invest S.á r.l. is an independent private equity company, registered in Luxembourg and managed by palero capital GmbH based in Munich.

Pursuing a sustainable approach to managing its investment portfolio, palero focuses on the operative development of the operations of the companies.

### Current shareholdings of palero:

<table>
<thead>
<tr>
<th>Company</th>
<th>Industry/Service Information</th>
<th>Year of Acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hakle GmbH</td>
<td>Household and sanitary paper</td>
<td>2013</td>
</tr>
<tr>
<td>VPC Group</td>
<td>Engineering services</td>
<td>2014</td>
</tr>
<tr>
<td>Krähe-Versand GmbH &amp; Co.KG</td>
<td>Workwear</td>
<td>2015</td>
</tr>
<tr>
<td>Felina Group</td>
<td>Lingerie</td>
<td>2015</td>
</tr>
<tr>
<td>EVANTEC GmbH</td>
<td>Technical services (in the nuclear field)</td>
<td>2015</td>
</tr>
<tr>
<td>Gallhöfer</td>
<td>Roofing supply</td>
<td>2016</td>
</tr>
</tbody>
</table>
VPC – History

1963
Established as ORGREB

1965
IfK is founded

1990
Formation of VEAG

1998
IfK is renamed VEAG PowerConsult

2002
VEAG purchased by Vattenfall

2003
Renamed Vattenfall Europe PowerConsult – engineering services and centre of excellence of the Vattenfall Group

2007
VPC East set up in Belgrade

April 1, 2014
Purchased by private equity company palero

VPC becomes an independent engineering company specializing in power plants and networks

2007
VPC East set up in Belgrade

2008
VPC becomes an independent engineering company specializing in power plants and networks

2016
Acquisition of 50% of the Indian company Encotec Energy (India) Pvt. Ltd. located in Noida
VPC – Services Portfolio

Studies and Consulting

Decommissioning and Dismantling Planning

Engineering Services

Maintenance, Upgrading and Plant Optimization

Design and Engineering, Construction Management and Commissioning

Operational Management, Measurements and Laboratory Services

Quality Assurance

VPC

Engineering Services
Design and Engineering, Construction Management and Commissioning

Maintenance, Upgrading and Plant Optimization

Operational Management, Measurements and Laboratory Services

Decommissioning and Dismantling Planning

Studies and Consulting
VPC – Organization Geared to Market Requirements

Chairman of the Management Board
Dr. Gilgen

- Human Resources
- BD* Turkey
- BD* New Energies

Sales
- Plant Engineering
- Environmental Technology
- Boiler Technology
- Process Engineering

Projects
- Major Projects
- Electrical Engineering
- Instrumentation & Control
- Grid Technology

Member of the Management Board
C. Müller

- IT
- Quality Management

Measurement & Materials Engineering
- Operational Management
- O&M Service
- Finance
  - Lausitz
  - Berlin
  - Hamburg

Subsidiaries
- Lausitzer Analytik GmbH (100 %)
- VPC East do.o., Serbien (100 %)
- Encotec Energy (India) Pvt. Ltd. (50 %)

*BD = business development
Agenda

- About VPC
- Services Portfolio
- Experience & Customers
VPC – Engineering

**Plant Engineering**
- Studies/concepts
- Basic engineering and detail engineering for new build and modification projects
  - Layout planning/piping engineering
  - Functional engineering
  - Turnkey plant modification projects

**Plant Optimization**
- Lifetime extension/flexibilization
- Optimization of load ramps, minimum load reduction
- Process optimization

**Electrical and I&C Engineering**
- Studies/concepts
- Engineering for new build projects
- Upgrading and optimization of plants
- Provision of electrical components

**Electrical Grids & Networks**
(everything from ultra-high voltage transmission grids to distribution networks)
- Grid calculations/simulations
Operational management
- Hazard assessments and safety management
- Environmental protection management
- Permitting and approval procedures
- Engineering services for dismantling/rehabilitation of obsolete plants
- Technical O&M management systems
- Document management

Measurement and Materials Engineering
Technical measurements
- Energy measurements on plants, energy studies
- Process quality monitoring
- Combustion analysis
- Emissions/immission measurements
- Model calculations/diagnostics
- Condition inspection/measurement on wind turbine rotor blades

Materials Engineering
- Destructive and non-destructive testing as part of maintenance measures on site and in the laboratory for damage assessment and lifetime monitoring
- Materials - Technical Consultancy and reports
- Quality assurance
Management of major projects

- Project management
- Permit planning/application documentation
- Claim and cost management
- Scheduling and controlling

Interface management

- Coordination of the different trades and work packages

Quality assurance

Site management and commissioning supervision
Management consultancy services, combined with in-depth and broadly based technical and practical experience

Assistance in the early phase of your project:
- Studies and market research
- Technology selection
- Technical and economic feasibility
- Due diligence
- Technical advisor in decision making

Customized solutions for problems, such as:
- Phase-out operation of plants
  - What is to be done?
- Operational Excellence – Operation and maintenance at minimum cost?
Services for regional energy projects:

- Implementation planning and permit planning
- Due diligence, consultation and support in acquisition processes
- Grid connections
- Supervision of construction work, including site management
- Innovative concepts for significant improvement in return on equity of existing plants
- Innovative concepts for reasonable acquisition of wind farms in Germany
- Development, engineering & permitting of hybrid power plants
- Optimization of operation

Enhancing the value of and return on wind turbine assets by...

- improving aerodynamic design (e.g.: winglets; boundary layer removal)
- blade angle measurements, correction and wind measurement in front of the hub
- optimization of operational monitoring by means of "dynamic" target-performance comparisons
- subsequent raising of hub height
- optimization of insurance premiums and insurance cover by application of an innovative blade scanning technique and by overhaul of assets
- optimization of financing on the basis of PPP schemes
Agenda

- About VPC
- Services Portfolio
- Experience & Customers
VPC – International Experience

- **Europe**: Albania, Bosnia and Herzegovina, Bulgaria, Czech Republic, Denmark, Estonia, France, Finland, Germany, United Kingdom, Greece, Hungary, Ireland, Italy, Kosovo, Latvia, Lithuania, Moldova, Montenegro, Netherlands, Norway, Poland, Romania, Russia, Serbia, Slovenia, Slovakia, Sweden, Switzerland, Ukraine

- **Far East**: China, India, Laos, Mongolia, Thailand, Taiwan

- **Middle East and Central Asia**: Georgia, Israel, Iran, Iraq, Kazakhstan, Kyrgyzstan, Saudi Arabia, Syria, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan

- **Australia**

- **Africa**: South Africa, Seychelles

- **Americas**: Brazil, USA, Canada
VPC – Customers (extract)

Energy utilities

- ABB
- AE&E
- AES
- AGL
- APG
- Dong Energy
- EMC
- EnBW
- Energetika
- EWS
- Elo
- EOE
- EWE
- 50hertz
- EON
- Gazprom
- N-Energie
- NUON
- StatoilHydro
- Terna
- WEMAG AG
- Vattenfall
- Rhein Energie
- Dniproenergo
- Trine

Municipal utilities

- enercity
- Stadtwerke Leipzig
- SWB
- SWE
- MVV Energie
- DREWAG
- Stadtwerke Cottbus
- Stadtwerke Frankfurt (Oder)
- Femernkraftwerk Neuköln AG

Industrial customers

- ALSTOM
- ANDRITZ
- AREVA
- BASF
- Oceanico
- Bechtel
- Bilfinger
- Cegelec
- Dragon Oil
- DTEK
- EPC
- Ferrostaal
- Giz
- Invensys
- MIBRA
- Mitsubishi
- Mitsubishi Hitachi Power Systems
- Rompetrol
- EPS

Development banks

- Bank of America
- Europäische Bank für Wiederaufbau und Entwicklung
- KfW

VPC GmbH | VPC Corporate Presentation | 2016-09-01
VPC – Engineering Made in Germany

VPC – More than 50 years of experience in energy sector projects

Everything from a single source

From the initial project idea to dismantling: Our in-depth engineering services cover the entire life cycle of your project.

With the eyes of a plant operator

Engineering and management based on a thorough understanding of your requirements and concerns as a plant operator.

Independent and neutral

Independent from suppliers and operators – best results for you!
... FOR BETTER RESULTS.
Technical measures for flexibilisation of coal fired power plants

Dr. D. Seibt, W. Apelt, M. Linke
Objectives

• Increasing of load flexibility to meet the power grid requirements
• Optimize part load operation in order to reduce the costs
• Minimizing increased lifetime consumption and additional maintenance costs

→ Considering the authority regulations (permitted emission limits and plant safety subjects)
Flexibility potentials

A) Reduction of minimum load

Objectives:
- Expanding load range
- Improving efficiency at low load operations

Investigation and evaluation:
- Model-based calculations to identify the bottlenecks of minimum load
- Conducting test runs to improve the combustion process and identify the optimal process parameters

Possible technical measures:
- Power plant modifications (retrofit with dried lignite firing system, optimizing of coal mills, integration of heat storage installations)
- Optimization of the I&C-System
Flexibility potentials

B) Reducing start-up time compared to design conditions

Objectives:
• Minimizing start-up time

Investigation and evaluation:
• Investigate the possibilities of increasing temperature gradients based on modified (higher) lifetime consumption

Possible technical measures:
• Power plant modifications (integration of gas turbines)
• Increasing cool-down time after shut down (installation of isolating butterfly valves in flue gas and air systems)
• Preservation of a defined temperature level after shut down (external steam, electrical heating)
• Material substitution (modification of wall thickness)
• Increasing flexibility against lifetime consumption without plant modifications (however an intensified monitoring of components is required)
• Optimization of the I&C-System
Flexibility potentials

C) Increased load gradients compared to design

Objectives:
- Increasing the load change rate

Investigation and evaluation:
- Evaluation of the current conditions and identify the improvement potential

Possible technical measures:
- Power plant modifications (integration of gas turbines)
- Material substitution (modification of wall thickness)
- Increasing flexibility against lifetime consumption without plant modifications (however an intensified monitoring of components is required)
- Optimization of the I&C-System
Technical measures for flexibilisation of coal fired power plants

References

• Power plant Moorburg (hard coal, 2x820 MW)
  - reduction of the minimum load to 26 %
  - installation of isolating butterfly valves in flue gas and air systems

• Power plant Jänschwalde (lignite, 6x500 MW)
  - retrofit with dried lignite firing system (including storage and transportation systems)
  - Reduction of the minimum load in duo and mono-operation

• Power plant Lippendorf (lignite, 2x 930 MW)
  - Reduction of the minimum load under warranty the use of steam for district heating