The stated objective of RWE Power AG and Evonik Steag GmbH was to modernize the turbines, increase efficiency and performance, extend lifetime and long-term availability, make turbines more flexible as well as reduce CO₂ emissions.

Customer benefits
Once the retrofit was completed and the unit returned to operation, the customer reported that the modernization provided the following benefits:

• The measured performance exceeded the guaranteed values
• Better operating characteristics than before the modernization

The plant
The coal-fired power plant Bergkamen, owned by RWE Power AG and Evonik Steag GmbH, is located in the Unna district, Germany. The turbine train was built in 1981 by former KWU (Kraftwerk Union) having a rated gross power output of 748 MW. It consists of one barrel-type high pressure turbine, plus one intermediate and two low pressure turbines. In 2006, Siemens was awarded a contract to perform a modernization of the high pressure (HP) and low pressure (LP) steam turbines.

The modernization was performed in 2008 and included:
• Installation of a new HP turbine and of two new LP turbines with the latest steam turbine technologies
• Commissioning of the turbo set

Dr. Engineer Christoph Köster, Project Manager, RWE Technology GmbH:
“The retrofit measures reduced the vibration in the steam turbine and the operating characteristics of the turbo set improved significantly. The guaranteed power increase was exceeded.”

Diplom-Engineer Robert Göstenkors, Plant Manager, Evonik Steag GmbH:
“The warranted power improvement of 30 MW was exceeded with 33.3 MW. The retrofit measures have contributed to the reduction in CO₂ emissions.”
Features
The following main features contribute essentially to the optimization of the steam flow path in the HP and LP turbines:

**HP turbine upgrade**
Increased efficiency and longer-term availability potential of the HP turbine was achieved through:
- New rotor
- New inner casing
- Advanced blading technology:
  Since the mid-90s, Siemens has been supplying three-dimensionally designed blades with reduced secondary flow losses (Fig. 1) which can be implemented in all various types of drum stages in HP turbines. This technology optimizes the blade path by a numerical method, which varies the stage reaction and stage loading, designed to result in optimized blade path efficiency.

**Advanced sealing technology:**
The following developments can help you to improve the efficiency and reliability of your turbine:
- **Brush seals at glands:** The brush seal consists of a backing ring and a bristle package, which does not take much more space than a standard seal strip. Brush seals are now used as add-on standard labyrinth seals. The qualified assembly of the brush seals results in a reduction of the gap between sealing and rotor. Gap losses can be reduced by up to approximately 50%.
- **Abradable seals at the balance piston:** Our seal segments are coated with a thin abradable layer (Fig. 2) comprising Nickel-Chrome composition and bentonite. The natural material bentonite is porous and allows local grooving of the seal strips. This helps to reduce leakage flow due to reduced clearances and to avoid damage of the seal strips. In addition, the larger metal clearances can help increase operability and reliability. This technology is designed for higher pressure drops as they occur, for example in balance pistons.

**LP turbine upgrade**
The LP turbine upgrade included:
- New rotor
- New inner casing
- New blading and advanced sealing technology
- Optimized inlet and exhaust cross-section (8 m²)

References
The successful completion of this project was based on our vast experience in steam turbine modernization projects, Siemens' integration of proven and newly developed methods, as well as our expert design and careful planning.

Please also refer to our product data-sheet "Altbach, Unit 1, Germany – Steam Turbine Modernization".

Published by Siemens AG 2017
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Article No. PSPG-B10208-00-7600
Printed in Germany
Dispo 34805
TH 288-161288 DA 0417

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